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frontispiece

Insect surveillance to prevent invasion of diseases, including yellow fever, is part of the daily routine of U. S. quarantine stations (see paper on yellow fever measures, pp. 1101–1106).

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24 pages. A summary and information on availability appear on page 1143.

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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PUBLIC HEALTH SERVICE
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Progress in Medical Research on Air Pollution

HARRY HEIMANN, M.D., L. OTIS EMIK, Ph.D., RICHARD A. PRINDLE, M.D., M.P.H., and WILTON M. FISHER, M.D., Ph.D.

For 3 years the Air Pollution Medical Branch of the Division of Special Health Services has been working in the increasingly more important but relatively unexplored field of air pollution in its specific relation to human health. The work began with a search for and a systematic appraisal of the scattered sources of knowledge, followed closely by tentative explorations into those parts of the problem holding promise of significant findings. Sufficiently successful results of initial activities helped chart the present course of action, which, in turn, points toward ideas requiring emphasis in the future.

THE Public Health Service has been concerned with the health aspects of community air pollution for many years (*1*, *2*). It was not until 1955, however, when Public Law 159 was passed by the 84th Congress, that the subject was accepted as of sufficient importance in itself to merit separate study. The Air Pollution Medical Program of the Division of Special Health Services was set up for this purpose in July 1955.

Specifically, the Air Pollution Medical Program was charged with the responsibility of determining whether or not community air pollution modified health among human populations. The first part of this charge involved the problem of definitions. What is meant by community air pollution? What are health effects? What should be the ultimate goal of the program?

For immediate use, air pollutants were defined as those materials in the community air that were contributed by the acts of man, excluding biological agents and radioactive materials (*3*). It was assumed that a community was an urban aggregation which might well cross political boundaries; it would have a large number of people potentially exposed generally to the same atmospheric air. Health effects were defined as those effects which might result in physiological or pathological changes which could be measured by objective techniques. The ultimate goal was seen early to be the definition of those agents in the air which cause deleterious health effects under specified conditions, so that appropriate steps could be taken to prevent or minimize these effects.

A wide variety of specific information was immediately available. For example, it was known that within the United States mortality rates for certain diseases varied from community to community; that eye irritation in the Los Angeles Basin was associated with the local smog (*4*); and that those who had died during the acute air pollution episodes of London (*5*), Donora (*6*), and the Meuse Valley (*7*) were generally elderly and frequently had preexisting respiratory or cardiac difficulties. From the same episodes and from other data there was evidence that the breathing of irri-

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Dr. Heimann is chief, Operational Research Section; Dr. Emik, chief, Laboratory Investigations; Dr. Prindle, chief, and Dr. Fisher, former chief, Air Pollution Medical Branch, Division of Special Health Services, Public Health Service. *This paper is based on a report prepared at the request of the National Advisory Committee on Air Pollution. The report was presented at a meeting of the committee in Cincinnati, Ohio, August 28, 1958.*

tants result in changes in respiratory physiology (*8–10*). There was evidence that ozone was toxic (*11–13*) and that rather large amounts were in the air of such areas as Los Angeles (*14*). There was also evidence that oxides of sulfur were present in many urban atmospheres and that they could adversely affect human health. Further, information from Great Britain indicated that observed variations in morbidity and mortality from city to city for some specific diseases were similar in pattern to the known or assumed intensities of air pollution.

A large amount of statistical data offered potentially useful information. But the data needed to be reoriented since they had been compiled for studies or activities unrelated to air pollution. A statistical section was organized in our program to study the application of these data to our purposes.

Two Courses of Action

We pursued two main courses of action. First, studies were designed to measure the health status of a community to determine whether aberrations in health patterns were related to indexes of air pollution. These activities were largely either field investigations or "desk" statistical studies. Second, studies were designed to define the biological or health effects of single or multiple known or suspected constituents of air pollution. These were largely laboratory studies. Thus, the program was divided between epidemiology and laboratory investigations, with certain activities, such as function testing of lungs, falling into both.

For the statistical work we knew that large bodies of data were in the records of vital statistics units throughout the country. Some quick and some more detailed examinations of these data from the viewpoint of specific diseases were essential to see whether any "good leads" were hidden there. Mortality data provide good, solid quantitative figures, but the quality of such data is not as good. For this reason we also needed to examine morbidity records whose accuracy of diagnosis was likely to be of much better quality. The Health Insurance Plan of Greater New York, the Veterans Administration, the Bureau of Old-Age and Survivors Insurance, and others collect extensive morbidity information. While such mortality and morbidity data were more or less readily available, we found practically no records of air pollution levels to which we might relate them. We had either to develop some kind of index of air pollution that could be applicable to any community or to use the limited data from those few localities where some air pollution measurements had been made. It was decided to do both. Air pollution indexes were developed based upon populations, industry, and fuel consumption for all American metropolitan areas. Detailed, although limited, aerometric information is being used in intracity comparisons. The analyses of these measurements are in process.

Epidemiology of Air Pollution

In the program's general responsibility for defining health problems of communities as they may relate to air pollution, we are employing, insofar as possible, the methods of epidemiology. This method originally was developed and applied to deal with communicable disease. In epidemics, an identifiable disease is present in unusual numbers in a given population. It is a relatively simple matter to divide the community into those who do or do not have the disease. When appropriate information has been gathered to describe the differences between these groups, it then becomes possible to investigate how the disease agent was distributed and how it was propagated. The contribution of the external factors of the environment can be estimated and, in some cases, even defined. More recently, the general utility and applicability of the epidemiological method, with various modifications, has resulted in its broad use in the study of mental disorders, home accidents, automobile accidents, heart disease, and even population control.

An identifiable disease or condition is not always evident in these studies. Only recently research has identified a group of organisms called the orphan viruses because they were not known to be associated with a disease. Surveys have shown that many people carry antibodies for these same viruses. Further investigation revealed the disease (*15*).

Those who investigate effects of air pollution on health are in the position of having a large group of potential agents and no specific disease. We suspect that nonspecific effects of air pollution disease now are classed in the catchall of "degenerative disease," or constitute conditions assumed to occur "naturally" in the population. Such conditions would include chronic bronchitis, pulmonary emphysema, and cardiac deaths.

It was necessary to begin our attack upon a broad front and be ready to change direction as information was gained. The pattern of occurrence of chronic bronchitis and lung cancer, on the one hand, and the episodes in Donora and London, on the other, strongly suggested that there were acute effects producing immediate changes in function, even leading to death, and chronic effects demonstrable only after months or years of exposure, or developing long after exposure had ceased. The study of these two phenomena required different approaches with different methods of identifying and quantifying the effects.

Current Developments

Although there is enough evidence to suggest strongly that air pollution can cause many adverse health effects, reliable medical data are not common. Consequently, we have had to search for facts which could withstand careful scrutiny.

The most important known way in which air pollution influences health is that it irritates, and so may possibly damage, membranous surfaces of the body. Our investigations into the recorded acute air pollution episodes show that the primary effects were observed on the respiratory tract with secondary, indirect, effects on the heart. In the Los Angeles area, air pollution appears to have a primary effect upon the eye membranes. The respiratory tract and the eye are particularly susceptible for the obvious reason that they are in contact with the ambient air; and, therefore, these organ systems will receive special attention in this discussion. However, investigations are underway on other matters such as allergy, cancer, and infectious disease. In a field where few guidelines existed we had to create and formulate new techniques on how to measure and evaluate the culpability of air pollution components, how to simulate actual air pollution in test situations, how to measure lung airway resistance, how to employ animal experimental "epidemiology," and how to establish and use air pollution indexes for expressing relative air pollution levels, relative to such elusive factors as intensity, duration, and locale.

Testing of Lung Function

One thing we have needed is a lung function testing method suitable for screening large numbers of people. Through some of our own staff efforts and our support of research at Harvard University, there is now at least one type of testing machine that seems to be suitable for the purpose (*16*). It indirectly measures the airway resistance to expiration. At the Occupational Health Field Headquarters of the Public Health Service a group is complementing the work being done at Harvard. They are considering how to provide the equipment and personnel suitable for testing a large series of people in their own communities and to determine how such procedures should be applied.

In addition, research at the University of Pittsburgh (*17*) and at the University of Cincinnati (*18*) also is concerned with the effects upon lung function of low concentrations of potential irritants. The development of such methods and tests will play an important role in community health studies, such as the current one in Nashville, Tenn. (*19*). Used in conjunction with information about environmental influences within a community, this type of objective medical examination can add significantly to the usefulness and reliability of epidemiological investigations.

Epidemiological Evaluations

There is also the classic type of straightforward epidemiological investigation in the program. The first such study was a reevaluation of the health of the population of Donora, Pa. (*20*) in the light of the 1948 air pollution episode (*6*). Preliminary data indicate that Donora residents who were adversely affected

during the 1948 episode were more likely to have more illness later than were those who apparently were not affected (*20*).

The epidemiological survey of the Detroit-Windsor area, a joint venture by the Governments of Canada and the United States, was begun before 1955. From the data seen thus far, we have been able to deduce some methodological ideas (*21*).

In Nashville (*19*), mentioned above, we are evaluating health patterns in a community where air pollution, when it occurs, is primarily soft coal smoke. The Nashville study has four broad aspects: (*a*) a study of mortality by cause and frequency in relation to place and duration of residence; (*b*) a study from postmortem examinations of carbonaceous dust accumulations in the lungs, also in relation to place and duration of residence; (*c*) a household morbidity survey to find out about acute and chronic disease in relation to place and duration of residence, and in relation, of course, to current air pollution measurements; and (*d*) a study of the influence of measured air pollution upon cardiorespiratory disease patients, including a group with bronchial asthma.

Laboratory and Statistical Studies

Another important approach with bearing on our field of interest is the observation of the effects of airborne irritants upon animals. There often is a high correlation between the effects of an environmental factor upon animals and its effect upon humans.

There are three ways that animals may be used in such investigations. First, wild and domestic animals may be examined for the effects of naturally occurring pollution. The following are cited as two examples of the many reports demonstrating this approach. Informed that the health of chickens was adversely affected by air pollution in the Los Angeles area, we supported a field study of this phenomenon. Because the results were inconclusive, the experiment is now being repeated under well-controlled conditions. Research conducted at the University of Southern California has shown that both the fertility of mice and the survival rate of newborn mice are reduced by long-continued parental exposure to inhalation of low concentrations of synthetic air pollution of the Los Angeles type (*22*).

The second way is to expose the animals under experimental conditions to single pollutants or multiple pollutants whose composition is more or less known. Of two such experiments being carried out at Vanderbilt University (*23*) the first is to determine exactly where in the respiratory tract the common air pollutant, sulfur dioxide, impinges to cause its effect. The second is to observe one series of animals exposed over a lifetime to sulfur dioxide at known low concentrations and another series exposed to bituminous coal smoke.

A third way of using experimental animals is to establish colonies of different species and strains under controlled conditions, and let them live out their lives in typical, urban areas where they would be exposed to the same atmosphere as that breathed by the human inhabitants. Simultaneously, observations would be made of a group of control animals for which the air is appropriately cleaned to remove the pollutants. We are currently financing such a study at Wayne University (*24*).

In statistical studies, the work is divided broadly into a study of records of past mortality by cause and past morbidity by cause in relation to environmental factors, including, of course, air pollution. At the same time our statistical unit is looking into recent and current frequency of causes of death and the frequency of illness. In both instances efforts have been concentrated on those clinical entities which might be causally related to air pollution.

The first report to come from our statistical unit was Comparative Mortality Among 163 Metropolitan Areas of the United States—102 Causes of Death (*25*).

The morbidity data for the current retrospective studies were collected from the Veterans Administration records of veterans receiving disability pensions and from records of persons enrolled in the Health Insurance Plan of Greater New York. From such data we have been able to make a preliminary estimate of the possible biological significance of only a small portion. Certain respiratory tract diseases appear to be frequently associated with

intense urbanization and, by inference, probably with intense air pollution.

To study specific diseases and body reactions believed to be associated with air pollution, the nature of the irritant action must be considered. While ophthalmologists for many years have used irritant materials to stimulate healing of some types of eye ulcers, experimental animals exposed to sublethal levels of ozone (a respiratory tract irritant) have developed pulmonary fibrosis. In both of these reactions, we have examples of the tissue-stimulating properties of certain air pollution components which in one case were beneficial to the organism and in the other harmful.

Nitro-Olefins

Theoretical considerations based on available data have indicated that, under the peculiar circumstances that may at times exist in the air of the Los Angeles Basin, nitro-olefins may be produced in that atmosphere (*26*, *27*). However, the presence of these compounds has thus far not been demonstrated, probably because of their labile nature. Despite this failure, we considered it important to study the noxious properties of the nitro-olefins. In investigations at the University of Miami to test their toxicity, 18 nitro-olefin compounds have proved to be highly damaging to animals, however they are administered (*28*). With high dosages, deaths occurred so rapidly that only acute congestion of all vital organs was found. When the specific stress factors of high temperature and humidity were added, deaths of the animals occurred even earlier. This confirmed other toxicological studies reporting that biological stress produced in any one of a number of ways, including physical exertion, intensified the effect of poisons (*29*). So far this investigation at the University of Miami has also confirmed some of the earlier toxicological studies of nitro-olefins. Our investigator at the University of Miami is now ready to begin long-term exposures to nitro-olefins in low concentrations, simulating what, it is believed, may occur in community air.

An adventitious observation was made in the early phases of the study of the nitro-olefins. The researchers found that their own eyes were strongly irritated when they handled the compounds or even when they examined the animals that had been treated with them. They, therefore, tried the effect of low concentrations on themselves, and found that at levels of air concentrations theoretically approximating those in the air of the Los Angeles Basin they again experienced symptoms of eye irritation (*30*). These experiments on eye irritation were repeated by an investigator working in Los Angeles, using a different technique; again, it was observed that eye irritation occurred with exposures to low concentrations of the nitro-olefins.

Ozone, Sulfur Oxides, and Aerosols

Other laboratory studies on the mechanism of action of known irritants have been pursued at the Occupational Health Field Headquarters. Most important were those involving ozone, a gas that has its effect in the deeper parts of the lung. Experimental animals exposed to concentrations lower than those previously considered injurious suffered fatal pulmonary edema (*31*). Animals repeatedly exposed to quite low, safe-concentration levels developed resistance to later exposures known to be toxic (*32*). It is possible that such a protective mechanism may be of importance in protecting man's lungs from injury under natural conditions. Exploration of the nature of this protective action has not been successful, so far. The phenomenon may be related to the fact that, in the test tube at least, ozone reacts with protein to form a new specific antigenic agent (*33*). If such a reaction actually occurs between ozone and the surface proteins in the human respiratory tract, it may explain why some resistance to later exposure occurs.

There was one finding already mentioned in another context that was rather disturbing. When animals breathed sublethal concentrations of ozone daily over a period of months, they developed scarring in the lungs (*34*).

Investigators working on lung-function testing have found that oxides of sulfur (gases produced by burning sulfur contained in small but significant amounts in many fossil fuels) caused increased airway resistance (*8*). This, it was observed, occurs with air concentrations

found on occasion in some urban communities. It has also been demonstrated that a derivative of sulfur dioxide, sulfur trioxide, in equal concentration is even more irritating than the dioxide (*9*). Both gases are produced when fossil fuels are burned. Finally, it was shown that the effect of sulfur dioxide, and of certain other irritant gases, is markedly enhanced by the presence of a solid or liquid aerosol which by itself may not be irritating (*35*). Aerosols of this type, of course, also commonly appear in the air, especially in urban communities. Irritating gases are not all necessarily enhanced by aerosols; the nature of the aerosol itself also is of significance (*36*, *37*). We are currently studying the possible mechanisms of this phenomenon. The thesis that the effect of an irritant gas on the lung is enhanced by the simultaneous presence of an aerosol, however, is not accepted by all investigators, but the preponderence of medical opinion favors it. Since it is impossible to conceive of natural air without the presence of an aerosol of some type, the matter may indeed be significant.

Tissue, Cell, and Enzyme Studies

Necessarily our studies of the action of these noxious agents on the body began at the primary level. Knowing that the body's response to membrane irritation would evoke a series of protective mechanisms that would mask the effect, we determined that one of the better ways to study membrane irritation would be in isolated cells and cell groups. We are promoting such an activity at Baylor University. Using a mixture probably containing nitroolefins as one of the toxicants, data thus far show that such air pollution adversely affects muscle contraction and leucocyte metabolism in special preparations (*38*). This continuing work has as its ultimate purpose the elucidation of the effect of such air pollutants upon the enzyme systems that are modified to produce these end reactions.

In line with these explorations, we also employed the tissue culture technique which is relatively unexplored for toxicological studies. This technique is applied to the study of cell preparations, generally of human origin, for changes in growth, reproduction, and metabolism. An authority in the field of tissue culture studies at the University of Nebraska undertook the project for us. Using tissue cultures about which a great deal is known (fibroblasts, cancerous cervical epithelial cells, and liver cells), the investigator showed that low concentrations of sulfur dioxide stimulate cellular activity; high concentrations of the gas are lethal (*39*). The effects of sulfur dioxide, nitrogen dioxide, salts of these acid gases, gasoline, and ozone are under continuing investigation.

Work on the causes and nature of eye irritation has progressed slowly. Research in California has produced some significant findings and it is now generally agreed among authorities that although the eyes of susceptible persons in Los Angeles become irritated when certain air pollution constituent levels are high, there are no objective changes in the eyes (*40*). In addition, the occurrence of eye irritation under experimental conditions is statistically associated with the presence in the air of a group of chemicals that include the nitroolefins, as mentioned (*41*).

Explorations at the Occupational Health Field Headquarters show that another body system may be affected by irritation from air pollution. While exploring the mechanism involved in the development of pulmonary edema from ozone, previously described, it was shown that there was a simultaneous decrease of certain enzymes including alkaline phosphatase in the affected lung tissue (*42*). A search was then made for the alkaline phosphatase level in the circulating blood as possibly being a more convenient indicator of lung injury. Again, the enzyme level was found to be altered. In the present state of knowledge we have not been able to extrapolate these findings to the human. But, if we should succeed in doing so, we may be able to detect the degree of lung injury simply by testing a blood sample.

Cardiorespiratory Disease

At the University of Cincinnati, a detailed study of house-bound cardiorespiratory patients revealed that the diffusion of vital gases across the respiratory membranes into the blood was adversely affected by peak levels of urban air pollution in the Cincinnati area (*18*). This

may indeed be significant. At the University of Pittsburgh attempts are underway to test the effects of irritant gases upon the lung function of experimental animals in which cardiorespiratory disease has been previously produced artificially (*17*).

In this connection, a Los Angeles pulmonary physiologist, during periods of high air pollution, has placed patients with known lung disease at the Samaritan Hospital in a special room where only cleaned air is allowed to enter. After a period of a few hours, these people show appreciable improvement in the function of their lungs, and so in their well-being.

Chronic Bronchitis

In addition to studying the nature of air pollutants, their effects on specific organ systems, and the method of evaluating their effects upon community health, we hope to observe the relationship of air pollution to specific diseases. At the California State Department of Public Health, investigations currently are underway on the effect of air pollution on the natural history of the diffuse clinical syndrome called chronic bronchitis (*43*).

Studies of the natural history of chronic bronchitis have been strongly influenced by experience in Great Britain (*44*). Air pollution in the British Isles, associated primarily with weather and use of relatively low-grade solid fuel, has been a subject of concern for years. The episode in London in December 1952 (*5*), to which some 4,000 deaths were attributed, led to intensive epidemiological study. Some significant concepts stem from these current investigations.

For some time chronic bronchitis has held a high place among the causes of death in Great Britain (*44*), certainly much higher than in the United States. Without going into the attempts to consider all the possible variables that may explain the reasons for the difference, it is the consensus of enlightened British medical opinion that they do, in fact, have a high frequency of this disease and that its occurrence is very likely associated with air pollution. In contradistinction to our predicament, they have identified a disease entity which they can relate to their air pollution.

In effective liaison with the British investigators (*45*), we are currently trying to clarify the reasons for the difference between their frequency of chronic bronchitis and ours. Prevailing judgment among qualified people is that the frequency of this disease in the United States has been increasing in recent years.

Bronchial Asthma

Bronchial asthma has also received considerable attention, but the results of several investigations are far from conclusive. A study in Pasadena, Calif., under the auspices of the California State Department of Health, involved a preliminary survey of the occurrence of asthmatic attacks in relation to certain air pollution variables (*46*). The results indicated that there was a doubtful association between certain high air pollution levels and occurrence of asthmatic attacks. This finding was unexpected, to say the least. Observations among asthmatic patients in the Nashville study may be useful in clarifying the matter (*19*).

One of the newest aspects of the Air Pollution Medical Program is designed to investigate the size of the health problem caused by airborne allergens of vegetative and related origins. Seasonal hay fever, it is estimated, attacks between 1 and 2½ million people in the United States; bronchial asthma is said to affect from ½ to 3½ million persons. We are also obtaining data on the degree of disability that these illnesses cause and their cost to the Nation in loss of working ability.

The concept that simple chemical substances may combine with body proteins to form a new substance which may be allergenic has played an important role in establishing our concern with airborne allergens or allergen precursors. Such precursors, simple chemical substances, may well be present in polluted air. We discussed briefly how ozone combined with proteins experimentally resulted in the formation of a new antigenic agent (*28*). The significance of that observation is enhanced by a report received a few years ago from the U. S. Army in Japan (*47*). It appeared that in and about Yokohama some persons of the Army of Occupation and members of their families developed symptoms of bronchial asthma on certain days. This was deemed to be due to

material discharged into the air from industrial operations. From the data supplied, the specific causative mechanism is not known. It cannot be ignored, however, that reports of this nature are rare. A few reports in the medical literature (*48–50*) have directed attention to an allergic response to sulfur dioxide in air; however, it is perplexing that despite the fact that sulfur dioxide is present in the air of so many urban communities, the reports are so rare. If the matter were looked into thoroughly, more reports might be forthcoming.

Respiratory Infections

Although infectious diseases are primarily the concern, in the Public Health Service, of the National Institute of Allergy and Infectious Diseases and of the Communicable Disease Center, our program has been probing the possibility that air pollutants may modify airborne infectious agents; they also may be a factor when exposed human tissue becomes vulnerable to infection. Early studies by others have suggested that airborne chemicals destroy some airborne bacteria and might, therefore, actually reduce the possibility of air-transmitted disease of the respiratory tract. What was not considered in those early studies was the possibility that air pollutants would alter the body membrane surfaces to make them susceptible to infection. A few years ago, researchers at Johns Hopkins University studied the occurrence of pneumonia in mice exposed to coal smoke and then to pneumococci (*51*). The data indicated that pneumonia did not occur more frequently in mice exposed to smoke. However, another investigator, working at the Armour Research Foundation under Air Force auspices, exposed animals to low concentrations of ozone prior to their exposure to airborne organisms, and found that pneumonia infection was of greater frequency in the exposed animals (*52*). We are currently supporting research at the University of California on the influence of ozonized gasoline fumes upon the pneumonia rate in mice, exposed also to a virulent pneumococcus (*53*).

Lung Cancer

The increase in the frequency of lung cancer throughout the world in recent years has stimulated universal interest. The most recent data point to cigarette smoke as a major factor. Cigarette smoking notwithstanding, some statistical studies have shown that the cancer rate is higher in urban areas with high air pollution levels than in rural areas with low air pollution levels (*54*).

It is generally accepted that the air can carry materials capable of acting as carcinogens. Acceptance of this belief is based in great part on work done with experimental animals. Industrial experience has shown that the air inside certain factories contains some carcinogens. It is not difficult, then, to understand that many of these same agents are released into the community air. Furthermore, such well-known experimental carcinogens as benzpyrene have been found in community air (*55*), as well as in exhaust gas from the internal combustion engine (*56*, *57*). Research conducted at the University of California at Berkeley has shown that such polycyclic hydrocarbons can be produced by combustion of even some of the simplest straight-chain hydrocarbons under suitable conditions (*58*).

Some epidemiological investigations of the lung cancer problem in Great Britain show that there is an association between urban living, frequency of lung cancer, and the presence in the air of certain polycyclic hydrocarbons already known to be carcinogenic for experimental animals. Preliminary statistical evaluation of certain American mortality data in our own program bears out the association between air pollution and lung cancer.

Currently in progress, in the second year of a 3-year job, is an investigation of the carcinogenic potential of the particulate matter collected in nine cities in the United States (*59*). For these nine cities there are relatively wide variations in lung cancer frequency.

Mucosal Changes in Air Passages

In considering the relationship of cancer of the lung (or possibly of other organs) to air pollution, some people deny a possible causal connection between the two because, they say, the amount of potential carcinogenic material in the air is too small to be biologically active. Although we can see no immediate resolution to the controversy on this matter that would

be acceptable to all, we do keep in mind that there are airborne materials which may act as adjuvants, enhancing the potential injurious effect of even small amounts of such carcinogenic agents. One of these adjuvant factors is the ability of some airborne compounds to remove and thus activate the carcinogenic polycyclic compound sometimes found adhering to an inert particle (*60*). Similarly, airborne irritants, because they can slow the rate of removal of potential carcinogens from lung airways, enhance the contact time between the carcinogens and susceptible epithelium (*61*). Finally, airborne irritants cause some denudation of the surface layers of the lining of the air passages, thus exposing the deeper, more susceptible layers to contact with potential carcinogens (*62*, *63*).

Some investigators have shown that airborne irritants, at least those from cigarette smoke, cause appreciable changes in the epithelial lining of the airways of the human lungs (*64*). These investigators believe that the changes are directly related to cancerous developments. Regardless of whether or not cancer is so related, it is still important that such irritation causes severe changes in the anatomy and in the functional activity of the human air passages.

The air passages naturally get primary attention in considering the relation between air pollution and cancer; but other tissues and organs also may be affected. A preliminary review of our statistical studies on the frequency of cancer of the esophagus and stomach reveals an association similar to that between air pollution and lung cancer. This finding may be related to some experimental observations wherein it was noted that animals exposed to various dusts showed an appreciable amount of dust in the intestinal tract (*65*). This finding also fits, to a certain extent, the occurrence of symptoms of stomach irritation that occurred in some of the recorded episodes of acute air pollution (*6*).

In the closing months of 1958, it appears that we can say definitely that several important and significant findings have emerged from our research on air pollution and its effects on man. Although further study is required in virtually all fields, it is obvious that we have uncovered some very promising leads.

Future Emphasis

Analyzing the progress of our program, we have reached the conclusion that during the next few years we can achieve the best results by concentrating research on five principal subjects:

1. The relationship of air pollution to variation in the geographic distribution of death and disease, by cause.
2. The association between air pollution and the functions of the respiratory system.
3. The association between air pollution and cancer and cardiovascular diseases.
4. The effects of specific air pollutants, singly and in combination, in accordance with the varying chemical and physical properties.
5. The fringe areas of air pollution health research.

Locale and Disease

In regard to the first, we have long known that there are important mortality differences among nations, among continents and, to some extent among ethnic groups. Only recently, however, have we begun to appreciate the fact that there are important differences in mortality among cities and that most of the differences may occur even among different areas within a city. There is now no doubt that urbanization exerts an effect on health. The higher the degree of urbanization, the more prevalent do some diseases become. We know, of course, that among the many variables that may contribute to these differences are the following: climate, socioeconomic status, ethnic or genetic composition, food and water supplies, availability of medical care, and the pattern of customs in medical diagnosis. Despite these other variables, however, we are convinced that air pollution is without doubt an important factor among the many potential causes of geographic variations in mortality and morbidity.

We started late in the field of epidemiology because of conceptual and operational difficulties, the necessity to acquire basic statistical data, and the unfulfilled hope that our initial laboratory investigations would provide information and directions that might simplify the human studies. Much of the required demographic data has now been acquired.

What are the principal results thus far of our epidemiological studies, preliminary though they may be?

1. There is evidence that the people who were affected by the air pollution episode in Donora in 1948 have more sickness and a higher mortality rate later than their fellow townsmen of similar ages who were not affected.

2. There is evidence that death rates for certain causes increase directly with degrees of urbanization. Specifically, these causes include cancer of the lung, cancer of the stomach and esophagus, and arteriosclerotic heart disease and certain other heart conditions.

3. Short-term increases in air pollution exposures cause changes in the lung function of persons with chronic cardiorespiratory impairments, and this effect may be delayed for 3 or 4 days after exposure. Exposure to "filtered air" may relieve these symptoms.

Admittedly, these findings are not as definitive or comprehensive as we would like them to be. We feel, however, that they are sufficient to justify the more intensive studies now underway, and those planned for the next few years. This means that we shall continue direct operational support of statistical analysis of morbidity and mortality data, community surveys (such as those at Nashville and Donora), and morbidity investigations similar to those on chronic bronchitis and bronchial asthma in California.

Irritants and Breathing

The second major subject has to do with the effect of air pollution on man's breathing ability. The effects found thus far are essentially those resulting from irritation. The important findings include the following:

1. Irritant gases, such as sulfur dioxide and ozone in amounts similar to those in community air, have an adverse effect upon man's ability to breathe.

2. Continuous or repeated inhalation of ozone scars the lung tissues of animals.

3. Exposure to ozone disturbs the alkaline phosphatase levels in the body, which may indicate that other changes in enzyme and metabolic activity are occurring.

4. Irritant gases cause pulmonary edema and affect enzyme systems and other physiological mechanisms.

5. Inhalation of some irritant gases mixed with certain aerosols that are usually considered physiologically inert increases the adverse effects of the gases.

6. On the other hand, repeated inhalation of small quantities of ozone, and possibly other gases, appears to result in a significant degree of increased resistance to the acute effects of ensuing heavier exposures.

These findings have resulted in the main from experimental exposures of animals. Their extension to human beings poses obvious difficulties of varying degrees, and in a few instances, efforts of such extension have already begun. We expect to continue to support and carry out the significant leads by the following: (*a*) evaluating pulmonary function; (*b*) continuing research grants in basic and applied pulmonary physiology; (*c*) direct investigations of effects on animals exposed to irritant pollutants; and (*d*) research contracts to groups using basic and applied physiological techniques. Although the basic laboratory work involving biochemistry, enzymes, and tissue cultures has shown promise, the findings can not yet be extended to man. Because of the basic nature of this research it is best supported by the research grant mechanism.

Cancer and Heart Disease

Our third major subject includes lung cancer, and possibly other cancers, as well as cardiovascular diseases.

No one can deny that heart disease and cancer are two of the important diseases in this country today. Together, they account for 54 percent of all deaths (*66*). Lung cancer, although accounting for only 1.8 percent of deaths (*66*) has been increasing rapidly in recent decades. Statistical studies relate this increase in lung cancer to cigarette smoking. A similar association has been shown with heart disease mortality, which, although less startling in percentages, is even more impressive in total numbers of deaths. What light, if any, have studies on air pollution thrown upon the causes of these diseases?

1. There is evidence that death rates for certain causes of death increase markedly with urbanization. Specifically, these causes include cancer of the lung, trachea, and bronchus, cancer of the stomach and esophagus, arteriosclerotic heart disease, and myocardial degeneration. The increase of lung cancer with population density persists even when the degree of cigarette smoking is held constant (*54*).

2. Fragmentary evidence of the distribution of cancer mortality within cities appears to be at least partially related to the distribution of air pollution intensity.

3. Certain air pollutants found in our cities are known to be experimentally carcinogenic for animals. Chemical analysis has disclosed many other potential carcinogens in air; these may also be carried by particulate matter deep into the lung.

Admittedly, these findings taken together would justify devoting our entire resources to following them up. However, the total air pollution budget of the Public Health Service, slightly less than $4 million, with about $1.5 million available for health studies, has powerful allies in the current annual Public Health Service appropriation for heart research ($46 million), and for cancer ($75 million). Consequently, the air pollution program is directed to encouraging those with technical and financial resources to undertake epidemiological and laboratory studies on environmental stresses in the community in general, and on air pollution in particular. For example, cooperation with the National Cancer Institute was arranged to determine the carcinogenic potential of air pollution particulate samples collected from nine cities by the National Air Sampling Network. The protocol was developed jointly with the National Cancer Institute and the Air Pollution Engineering Program. The Air Pollution Medical Program paid part of the cost of the first year. The National Cancer Institute assumed the total cost for the second year.

Animal Studies

The fourth subject deals with the effects of different air pollutants. All our previous experience indicates that the chemical and physical nature of substances are important in determining their biological effects. We have not devoted much effort to studying the effects of specific substances, largely because our air sampling information indicates that, as an acute problem, the community levels found are too low, and that as a long-term problem it is not possible to isolate effects due to one substance from those due to others. We have, however, promoted research work on the effects of mixtures of pollutants and especially those that generally simulate the type of pollution in Los Angeles. Some of the significant leads that stem from those studies are the following:

1. Certain nitro-olefins believed on theoretical grounds to be present in Los Angeles air may be among the factors that irritate eyes. Synthetically prepared nitro-olefins have been found to be highly irritating and rapidly fatal to animals in acute exposures. At concentrations believed possibly extant in Los Angeles air at times, they cause eye irritation in man.

2. There is diminished oxygen uptake and decreased growth of micro-organisms exposed to simulated Los Angeles type of air pollution.

3. The fertility of experimental mice and the survival rate of newborn mice seem to be reduced by the artificial Los Angeles type of air pollution.

The Los Angeles area has made great strides in controlling its original sources of air pollution. The most important remaining uncontrolled source of pollution in Los Angeles is said to be the internal combustion engine. Because of special budgetary considerations we expect to be able to expend a large sum during the next fiscal year on the study of automobile exhaust gases and their toxicity. These studies will be based in part upon a research facility that will generate, monitor, and analyze various types of light-irradiated exhaust gases and will then feed them to exposure chambers designed to study the effects on vegetation, microorganisms, and small experimental animals.

Fringe Areas of Research

Our fifth subject, the fringe areas, includes those problems which appear to be of primary concern to researchers who are not in air pol-

lution work. One example is that of the inhalational allergies. This subject is divisible into two aspects. First, the familiar plant pollens, causing hay fever and similar reactions. Second, the question of whether or not chemical conditions in air can cause allergic reactions in some susceptible people.

Another example in this fringe area is the effects of air pollutants which reach the gastrointestinal tract. If our pilot studies of such questions indicate the serious possibility of important findings, we are prepared to follow through.

Long-Range Goals

We have described a blueprint for the near future. These are the things we are doing now or will be doing during the next 2 or 3 years. Medical research in air pollution from the long-range aspect, we believe, will be the following:

First, we think we shall some day return to the consideration of effects upon cells and tissues. Methods will eventually be developed whereby we will be able to extrapolate the observed effects to intact animals and to human beings. Controlled exposures of isolated cells and of tissues will then be a screening device.

Second, we expect that we shall develop realistic maximal permissible concentrations, based on reliable studies and adaptable to the industrial and meteorological conditions of a given city.

Third, we think that the public health engineer and the public health physician will participate much more in studies of community ecology, in planning and zoning programs, and the like. The advantages and disadvantages of alternative proposals may be evaluated, not only in aesthetic and economic terms, but with reference to present and future effects upon the health of the community.

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New Laws Affecting Health Activities

The following legislation affecting health was passed by the 85th Congress during its second session:

P. L. 85–544 authorizes the Surgeon General of the Public Health Service, for fiscal years 1959 and 1960, to make training grants totaling $1 million annually to schools of public health (H. R. 11414).

P. L. 85–664 extends the Hospital Survey and Construction Act for 5 years (H. R. 12628).

P. L. 85–589 amends the Hospital Survey and Construction Act to permit applicants to obtain loans in place of grants for the construction of hospitals and related facilities (H. R. 12694).

P. L. 85–777 extends for 3 years the Health Research Facilities Act, which authorizes $30 million annually for research construction grants (H. R. 12876).

P. L. 85–840, among other Social Security Act amendments, increases by $5 million each the annual appropriation authorizations for three State grant programs administered by the Children's Bureau: maternal and child health, crippled children, and child welfare (H. R. 13549).

P. L. 85–908 provides for White House Conference on Aging in 1961 and authorizes Federal financial aid for preparatory State conferences (H. R. 9822).

P. L. 85–926 provides for grants of up to $1 million to institutions of higher learning to expand educational opportunities for mentally retarded children through teacher training and other programs (H. R. 13840).

P. L. 85–929 amends the Food, Drug, and Cosmetic Act to prohibit chemical additives in food that have not been pretested for safety (H. R. 13254).

The Chronic Disease Laboratory in Public Health

ALBERT L. CHAPMAN, M.D.

IN A TIME when the triumphs of technology have literally made real many of man's most fanciful dreams, I may be pardoned if I venture some bold ideas about the future of laboratory work in public health.

I honestly believe that we shall live to see the time when laboratory tests will penetrate the mysteries of the chronic diseases. I believe that, ultimately, laboratories will be able to identify most, if not all, of the leading chronic diseases through simple, valid tests that will be economical to perform.

For example, the "fingerprints in the blood" which we are only beginning to understand may eventually reveal through the analysis of a single blood sample the presence or absence of a whole array of chronic conditions. Most important, such future testing can detect the presence or even the threat of a chronic disease in ample time to heed the warning.

Medical science, by its conquest of the infectious diseases, has not ended an era. Rather, it has opened an even greater era, which will be known in history for victories won over the chronic diseases. And, as in years gone by, laboratories again will be the shock troops in the attack that has now commenced.

Some 70 years ago, a small room in the Marine Hospital on Staten Island, N. Y., was set aside as the first Public Health Service laboratory. It wasn't long before States set up similar laboratories all over the country. These laboratories have been landmarks in the progress of the modern public health movement in the United States.

Epidemiology, the central discipline of public health, cannot exist without the laboratory, any more than the automotive industry can exist without highways.

No reminder is necessary of the amazing progress in laboratory testing in recent decades. Progress has been equally notable in pathology, biochemistry, toxicology, bacteriology, mycology, parasitology, and serology.

In an effort to determine the extent to which State public health laboratories had expanded into the chronic disease field, the American Public Health Association's Committee on Laboratory Services in the Chronic Diseases sent out a questionnaire in 1957 to State laboratory directors.

Having been granted the privilege of quoting from the interim report based on that questionnaire, may I first commend one of its introductory statements:

"Since the chronic diseases fall for the most part in that category of illnesses . . . in which secondary levels of prevention, such as early diagnosis and treatment are important, it seems obvious that the laboratory should have a place in their control."

In connection with this philosophy, a most important finding of the questionnaire is that 20 out of 32 State laboratory directors who responded believed in the need for providing chronic disease services in their laboratories. Only 7 of those reporting did not so believe.

The interim report shows that 11 State laboratories are now performing a significant number of tests in the chronic disease field in addition to blood grouping or blood typing.

Certain States (Maryland and Wisconsin are discussed in the interim report) are already engaged in large-scale chronic disease testing

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Dr. Chapman, an Assistant Surgeon General, is chief of the Division of Special Health Services, Public Health Service. *This article has been adapted from an address by Dr. Chapman at a meeting of the Western Branch, American Public Health Association in British Columbia, Canada, on May 20, 1958.*

in a wide range of areas. Surprisingly, lack of funds was given as the major reason for not expanding chronic disease laboratory services. Lack of space and lack of trained personnel were listed as other obstacles.

If funds and personnel were available, 15 States indicated they would undertake blood sugar determinations, 14 would do Papanicolaou smears, 13 would do blood grouping, and 9 would start blood chemistry. Many other types of testing would be initiated in other States.

In a supplementary inquiry, the Division of Special Health Services, Public Health Service, recently polled the State health department laboratories again, using regional office staffs to gather the data.

We were interested mainly in learning the extent to which some of the basic tests were being performed by State laboratories. The results corroborated the earlier findings. A great deal of valuable work is being done along these lines.

No fewer than 19 States reported blood sugar testing: 9 of these were engaged in screening; 5 in routine quantitative testing; and 5 reported use of the clinitron.

Nine States test for blood cholesterol.

Twelve have programs for examining Papanicolaou smears.

Five do rheumatic fever (antistreptolysin titer) testing.

Two test for rheumatoid arthritis.

A variety of other tests are being performed by one or more States, including, of course, blood grouping, blood typing, and urine analyses.

Although it appears that a significant amount of chronic disease testing is performed by many State health department laboratories, we must face the fact that 20 States reported no testing of any kind for noninfectious diseases. I believe that this picture will change. It is bound to.

New Tests and Machines

Several exciting new tests and possibly even more exciting new machines are now being used by testing laboratories.

The Papanicolaou smear is not a new test, but its application in large-scale casefinding programs is relatively new. Recognition by the public health and medical professions of the great possibilities of the cytological test for cervical cancer is truly exciting. This simple, usable, and teachable test has brought one important phase of cancer prevention within the range of classic public health and preventive medical practice. The laboratory has made this possible.

Another exciting cancer advance is perhaps foreshadowed by the work of Dr. Claude Hitchcock of the University of Minnesota, who reports that screening for low acid content or absence of acid in the stomach is an effective means of diagnosing gastric cancer in the asymptomatic phase.

Screening 12,000 men and women over a 10½-year period, Dr. Hitchcock found the incidence of cancer 4½ times greater among patients with no acid or a low acid content of the stomach. He recommends annual gastrointestinal X-ray examination for the latter group and an examination every 9 months for the former group.

In the bentonite flocculation test, a type of colloidal clay (bentonite) is mixed with normal human gamma globulin. When the test is positive the clumping or flocculation of the mixture can be seen under a microscope in a few minutes. This test was positive 85 percent of the time when used on 82 verified cases of rheumatoid arthritis at the National Institutes of Health.

A new approach to the prevention of rheumatic fever is heralded by a testing process employing a fluorescent dye to "tag" serum antibodies. (See *Public Health Reports*, October 1958, p. 884.) This method, if it proves applicable, promises to be fast and simple. Positive results may be reported on slides containing only 200 bacteria. Conventional tests require as many as 100 million organisms, the culturing of which may take a week or more. Most laboratory technicians can perform the fluorescent dye tag test, given the training and equipment.

Never in the 70-year history of public health laboratories in this country has the development of new laboratory tests moved at so rapid a pace as during the last decade. Fresh progress is reported monthly.

To mention only a few of the testing machines, machines that are as exciting as the new tests themselves, the great utility of the Papanicolaou smear may now be enhanced tremendously by an electronic machine called the cytoanalyzer. This device supplements the technician in the microscopic search for malignant cells. Abnormal cells are counted electronically on the basis of structural characteristics. The cytoanalyzer, when perfected, has the potentiality of screening thousands of slides daily. Seldom has an invention more perfectly fitted the needs of casefinding.

For blood analysis, among several new machines introduced on an experimental basis is the autoanalyzer which performs, through the use of automatic colorimetric analysis, routine determinations of urea, sugar in blood, and calcium in serum. The results of the analysis of the blood sample, indicating the concentration of certain substances in the blood, are permanently recorded every 90 seconds, permitting 40 determinations an hour.

Disease "Fashions" and the Laboratory

Laboratory practices reflect the current "fashion" of prevailing disease. Today, blood is being fractionated and the characteristics of these fractions are being determined by many new methods: spectroscopy, electrophoresis, and paper chromatography. A whole new armamentarium of disease detection is slowly but steadily being developed.

During the early decades of the 20th century when such diseases as smallpox, malaria, diphtheria, pneumonia, typhoid fever, tuberculosis, dysentery, and the communicable diseases of childhood were the primary threat to life, laboratory practices reflected the logistical importance of these diseases.

With the aging of our population and the relative increase in incidence and importance of the chronic noninfectious diseases, laboratory practices are slowly but steadily beginning to reflect the growing importance of these currently more "popular" diseases.

There has been a significant lag in the widespread use of available tests for noninfectious diseases, few as they are, partially because of difficulties in retraining professional and other laboratory personnel in new methods of laboratory analysis. Some of the lag can be attributed also to the belief that public health laboratories should not become involved in tests for noninfectious diseases; and some of it has been caused by the scarcity of precise and economical tests.

But much of the lag, in my opinion, can be traced to inadequate funds and inadequate staffing of public health laboratories. These inadequacies, of course, are attributable in large part to the lack of appreciation of the value of laboratory procedures in the early detection, diagnosis, and control of the chronic, noninfectious diseases, and the lack of public and professional support for expansion of these activities.

When mass chest X-ray programs were first introduced, the demands for the services of private radiologists increased because of the many new cases of treatable tuberculosis that were found. I am confident that this phenomenon will be repeated when adequate methods and facilities are developed and put into widespread use to insure the early detection of unsuspected cancer, diabetes, heart disease, and arthritis. In fact it seems that the importance and stature of clinical pathologists will rise in direct proportion to the expansion in the number of laboratory tests that are done on apparently well persons for the purpose of identifying asymptomatic diseases.

The battle against these noninfectious killers is a common battle. The private physician and the clinical pathologist are fitted to lead and direct the various campaigns against them. Public health physicians and their staffs and the directors of State and local health department laboratories and their staffs are in a position to give invaluable assistance to private physicians and clinical pathologists so that the efforts of all of the professional groups concerned may be effectively coordinated. Through their joint action, the public is bound to benefit.

MAN and Environment

CONFERENCE REPORT

To examine research needs in the modern environment, the National Institutes of Health, upon the recommendation of its Study Section on Sanitary Engineering and Occupational Health, called the Conference on Man and Environment in Washington, D. C., May 5–6, 1958. The following pages carry information from six of the papers presented.

The Modern Environment

brief

It is not necessary to study vital statistics to perceive some of the more glaring hazards of modern life. Yet the severity of these hazards cannot be viewed in proper proportions without quantitative information. Many departures from an earlier way of life have occurred within the past two generations, and thus the vital statistics of any earlier time and the mechanisms for their collection are hopelessly inadequate.

We are aware, however, of a heavy toll of deaths and injuries on the highways and in the homes; of accidental poisonings, especially among children, so numerous as to require regional and local poison centers for the prompt transmission of information and advice; of public apprehension concerning the functions of airborne carcinogenic agents, whether from the partial combustion of petroleum or tobacco, in inducing or contributing to the induction of lung cancer; of heated controversies over the treatment of community water supplies; and of the contamination of foodstuffs with insecticides and other foreign substances. And we contemplate with great uneasiness the dispersion in the air and the deposition on the land and in the sea of increasing quantities of radioactive substances. These are on the horizon of the average citizen.

Certain other features of the modern environment appear to have graver significance in their capacity for present and future harm. Never before has man at work been surrounded by so many obvious as well as insidious dangers to health, limb, organic integrity, and life itself.

By the study of accidents and illness we learn the causes of injury, disease, and death. But what are the consequences, throughout a working life, of the almost daily impact of individual and collective insults of minor or subclinical severity? Those with more complacency than curiosity, with more faith in physiological adaptability than can be justified by medical evidence, and with undue comfort derived from crude statistics will respond that the people in no previous society have been known to die young in such small numbers and to live to be old in such large numbers. The easy conclusion is that Americans are healthier now than ever before and that modern life holds no very serious threat to health. But consider the facts less superficially.

Based on a paper by Robert A. Kehoe, M.D., director, department of preventive medicine and industrial health, University of Cincinnati, Cincinnati, Ohio.

Changing Statistics

The microbiological era of medicine and public health has profoundly changed the practice of medicine, has brought into existence and cultivated the techniques of preventive medicine, sanitary engineering, and public health, and has made revolutionary changes in the statistics of human morbidity and mortality. The microbiological diseases, almost to the exclusion of all others, have occupied the attention of the medical practitioner, the investigator, and the educator for more than 50 years. Only recently, compelled by the changes in the causes of illness and death, has attention begun to shift proportionately to chronic degenerative diseases.

Meanwhile the environment of the Nation's population has been changing. The microbiological threats to human life and health have been replaced by the inanimate threat of the machines and materials which inventive man has made, and by the forms of energy with which he has surrounded himself. The physical basis of modern industry is something new under the sun—an environment which, in the making, has taken so much of man's total time, effort, thought, and ingenuity as to leave him little to expend on learning what might be its ultimate effects upon himself.

Not only is the incidence of occupational disease unknown because suitable mechanisms for reporting and assembling information are lacking, but great areas of industry are not under such observation as would provide this information. It is by no means certain, therefore, that the effects of the composite hazards of industry have not affected the national health since, in our gross morbidity and mortality statistics, the brilliant results of microbiological prophylaxis and therapy may have masked these effects. We do not know, and we have no present means of knowing, just

what has resulted from the profound changes wrought in the industrial environment by modern technology.

Why are we not more deeply concerned about what has been happening to us during the last half century within the revolutionized environment of our daily work? The time has come when we must carry out physiological and hygienic research hand-in-hand with technological research and when we must develop the techniques of industrial hygiene stepwise with the technology of production.

Health in an Industrial Society

If we are concerned about our industrial population, we also should be concerned about our population generally, for the industrial environment has become, to a remarkable extent, the national environment. This environment which man has created for himself now provides the challenge to both curative and preventive medicine, a challenge that requires additional types of medical knowledge, new medical skills, and new settings.

What of the artificial situation in which many new materials, possessing infinite possibilities for metabolic modification, find their way into the body of man? Is it not evident that our attempts to detect signs of the early or late injurious effects which may follow the absorption of these materials over a period of years or a lifetime are somewhat crude and even naive?

We shall never be able to anticipate and visualize the harmful potentialities of new materials until we achieve a comprehensive understanding of the role of the normal elements and other components of the living organism. Within such a comprehensive background, however, we could probably discover metabolic deviations induced by chemicals now within the organic milieu.

No principle of biology is clearer than that which relates a physiological response to a quantity of stimulus within appropriate time limits. The living organism is resistant in varying degree to varying stimuli, and the stimulus must be adequate to induce a response. Upon this principle we differentiate between harmful and harmless stimuli. In these terms, toxicity relates not to a specific substance but to the concentration of a substance within certain time limits in the tissue or chemical system of an organism. A toxic environment, therefore, is one which, within certain time limits, introduces a harmful quantity of a substance into the organism.

In modern times the changes man has wrought through his technology have brought about greater environmental changes of more profound physiological significance than have all the previous generations of men. The time has come, however, when a much greater and more comprehensive knowledge of the consequences of our changed and changing environment is essential for our safety and perhaps for our very survival.

Technology has created a wealth of materials and captured the forces of nature for man's use, but it has failed to bring an understanding of their biological effects that will keep these forces and materials under control. The gap between technology and biology must be reduced before it is too late. It must become an axiom of modern chemical and technological research that the materials produced and the energy harnessed must be as well understood for their biological potentialities as for their physical and mechanical properties.

Reckless man can release or build up physical forces which may destroy himself and his kind. Probably, however, the same ingenuity which has enabled him to explore and to penetrate other secrets of nature will serve him when he expends it in learning more of his own vulnerability and in developing the means for self-protection.

Water Supply

brief

Our research needs may be stated simply: to augment supplies of water by novel means, to reduce water loss, and to treat polluted water for re-use.

By 1975 the use of converted sea water to augment the water supply in coastal cities may

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Based on a paper by Mark D. Hollis, Assistant Surgeon General and chief sanitary engineering officer of the Public Health Service.

be feasible and perhaps routine. Novel methods under study offer promise that the ocean may be effectively and economically tapped. At present full-scale plants can distill sea water at a cost of $1.75 to $2.80 per 1,000 gallons. The goal is $0.30 per 1,000 gallons.

While present weather modification techniques may be crude and ineffective, we must accept them as a potential means of increasing the supply of water. The President's Advisory Committee on Weather Control concluded that cloud seeding produced an average increase in precipitation of 10 to 15 percent in mountainous areas of the western United States.

A substantial part of our future water needs may be met by conservation of flood waters, control of losses through evaporation, recharge of aquifers, and the use of hexadecanol in monomolecular layers on water surfaces.

A 10-foot stratum of sandy soil of average porosity underlying a watershed will hold the greatest single flood flow likely to occur on that watershed. Although we now have no way to use water-bearing strata effectively in flood containment and water conservation, more intelligent use can be made of underground reservoirs to supplement surface storage.

Water lost by evaporation in the United States exceeds the amount taken for use in cities and towns. It has been estimated that evaporation from storage units now under construction in the Colorado River system will equal more than one-third of the replacement storage they provide. Research on the use of monomolecular films of long-chain fatty alcohols to suppress evaporation, however, supports optimism concerning the ultimate ability to reduce evaporation by nearly one-half.

Reclaiming Water

Water supply research, however, must concentrate on new processes to reclaim water. Reuse of water is complicated by the growing number of contaminants in solution. The treated drinking water of a community contains an intricate mosaic of stable organic chemical structures which reflect the past history of the supply. To this burden of chemicals, the community adds its increment of solids, including soluble, persistent, nonoxidizable compounds like the alky-benzyl-sulfonate component of detergents. The Nation's use of detergents, 3 billion pounds per year in 1956, is expected to double within the next decade.

Drainage from land treated with insecticides, weedicides, and other materials adds to the load of persistent organics now being recovered from all parts of the main stem of the Mississippi River. DDT, in a concentration of 5 ppb, was recovered from Lake St. Clair on the Canadian boundary. The Department of Agriculture's large-scale imported fire ant control operations in the southeastern States eventually will apply dieldrin and heptachlor to some 30 million acres. The United States' production of pesticides and other organic agricultural chemicals rose from 125 million pounds in 1947 to 570 million pounds in 1956.

Management of impoundments, including municipal water reservoirs, for recreational use is also influencing the character of drinking water.

Conventional yardsticks of pollution, B.O.D. (biochemical oxygen demand) and coliforms, give few clues to the presence of these synthetic organic pollutants. Advanced studies on adsorption may indicate useful supplementary treatment for municipal water supplies. Methods for separating dissolved solids from water also are being investigated in connection with desalination.

The toxicological significance of organic chemicals in drinking water has not yet been adequately evaluated. Because of the high cost of toxicological evaluation, a short-time, presumptive test to determine the chronic toxicity potential of specific or complex materials is required.

Particulates and Viruses

Concern with dissolved contaminants does not detract from the familiar problem of particulates. One of the most surprising findings in the recent Chanute, Kans., study was the large amount of organic debris of particle sizes up to 20 microns appearing in the filtered water. This observation supports the opinion that a critical review of filter design criteria is in order. These criteria have not been changed in any important respect in the last

generation, in spite of knowledge that the conventional rapid sand filter is less effective than properly controlled chemical coagulation in turbidity removal and less reliable than breakpoint chlorination for micro-organisms.

The assessment of the public health aspects of viruses in the water environment requires improved methods for recovery and identification of viruses, especially in the treatment of water. Also the transmission of infectious hepatitis virus through contaminated water emphasizes the need to develop a tissue culture technique for the growth of this virus.

These are some basic problems of water supply. Should we concede that the routine identification of unknown substances, inert or organic or viable, in water is too difficult? Because of this difficulty, would it be practicable to require the polluter to purify waste completely? Are we giving sufficient attention to the possible adverse cumulative effects of foreign materials in drinking water?

Or, in view of the level of health in our metropolitan areas, are we magnifying unduly our water supply problems? Our concern about some of this is admittedly potential and based on lack of data, especially of the toxicological implications.

For the immediate future, professional judgment will have to be applied to these issues. But the supporting data, through research, should be sought as promptly as is feasible.

Water Pollution

brief

The impact of the development of modern metropolitan areas is of great significance in man's environment. The total population growth of the United States has not only been high but has been taking place almost entirely in the Nation's 174 metropolitan areas, which the Bureau of the Census defines as areas containing at least 50,000 persons with population densities, by counties, exceeding 150 persons per square mile.

The 16,000 units of governments and 3,000 special districts within these metropolitan areas give a measure of the complexities of administration in such tasks as the collection and disposal of waste water used by their inhabitants. A recent book, Special District Governments in the United States, decries the multiplicity of these units, and its author, J. C. Bollens, concludes that special districts are justified for schools but feels that other activities should be returned to local governments.

If a sanitary engineer surveyed the collection and disposal of waste water in metropolitan complexes, he would certainly conclude that special districts are justified for sanitary engineering activities as well as for schools. The fact that the metropolitan area is being used more and more in providing for waste water disposal would seem to justify them.

Perhaps a study of this approach could either assure its continuation or point the way for improved and more economical approaches to water pollution control in metropolitan areas. Such a project would have important economic as well as engineering aspects.

Odor control in sewers, pumping stations, and treatment plants is a definite need in waste water treatment. Fundamental work on odor-causing compounds and odor intensity measurement was done at Harvard University more than 25 years ago. Since that time much has been written about sources of odors and how these may be controlled through cleanliness in the plant and chemical treatment.

While cleanliness is essential, the fullest control of odors has been achieved at the Owl's Head plant in New York City through plant housing with exhaust gases discharged through a stack after treatment with ozone. A circular trickling filter at Sarasota, Fla., uses plastic covering on an aluminum frame for a filter cover. Research in odor control could be a re-evaluation and extension of the work at Harvard. Experience to date seems to indicate that the most reliable control is the housing of plant units and treatment of the exhaust air. Basic information on the economy of various designs would be helpful.

Further research in higher degrees of waste water treatment could also be done. At present a 90 percent removal of B.O.D. is looked upon as "complete" treatment. However, satisfac-

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Based on a paper by Ralph E. Fuhrman, executive secretary, Federation of Sewage and Industrial Wastes Associations, Washington, D. C.

tory disposal of treated hydrowastes will become more necessary in future years because the volume of wastes to be treated will increase and the volume of a receiving stream will remain constant.

With the processes now established, stabilization ponds or intermittent sand filters may be relied upon to reduce B.O.D. residuals to 5 percent or less. But devising processes practicable where the large areas required for these methods are not available would aid the reclamation of water for re-use for purposes other than drinking or cooking.

It is important to watch continually the publication of research reports. Unpublished research work remains hidden from most other researchers. For this reason, all research, whether or not it appears productive, should be reported at its conclusion so that the wasted effort and money to repeat it can be avoided. As a minimum step, condensations of lengthy reports or theses should be offered for publication in the technical press.

Re-use of Water

brief

The most important research needed in water pollution is in the reclamation and re-utilization of waste waters. Acute shortages of fresh water, long a problem in the arid west, are beginning to plague areas of the midwest, east, and south as the demand for water skyrockets. Man's greatest impact on his water resources is his increased demand for fresh water and his reckless pollution and abandonment of once-used water.

Among the consequences demanding new or improved knowledge are:

- The survival rates and destruction mechanisms for all types of pathogens in various treatment processes.
- The calculated risk in health hazards and other detrimental effects associated with use of waste waters for irrigation, recreation, stock watering, and perhaps for human consumption.
- Mechanisms for the removal or inactivation of sulfates, nitrates, and phosphates, especially in waste waters being used for ground-water recharge.
- The modifications of polluted water as it flows through porous media of varied geochemical composition, and, conversely, the effect of such water upon soil structures.
- Systems analysis in the water balance of an area.

Based on a paper by J. E. McKee, professor of sanitary engineering, division of engineering, California Institute of Technology, Pasadena.

Air Pollution

brief

The following listing of the present problems of air pollution is a composite of the convictions of a number of informed people. It is probably significant that each one suggested essentially the same listing, although there was no general agreement on the relative importance of the items.

Chemistry of Air Pollution Systems

Substances causing eye irritation, accumulations of ozone, damage to vegetation, and possible physiological damage in man appear to be labile, transitory constituents of an ever-changing system and therefore have proved difficult to measure or identify. Their existence appears to depend on the photochemical formation of free radicals, if indeed certain types of free radicals are not responsible for the observed and suspected effects. Since the existence of free radicals is essentially co-terminous with the activating solar energy, capture and analysis apart from the continuously activated system have not been accomplished or seriously attempted.

Of course, the primary reactants involved in the chains of reaction can be recognized; in Los Angeles the elimination of oxides of nitrogen and of organic vapors, especially the unsaturated compounds, would effectively inhibit the formation of the suspected labile intermediate compounds. But it has proved difficult

Based on a paper by Leslie A. Chambers, director of research, Los Angeles County Air Pollution Control District.

to ban by fiat either of these two classes of reactants. It is my opinion that the practical form of control of such reaction products will prove to be a selective elimination of those species of primary compounds determined to dominate the identified chain reactions.

Sulfur Compounds and Aerosols

Still missing is considerable information about what happens to sulfur compounds in photochemically activated atmospheric systems. Prof. H. Fraser Johnstone and associates are contributing valuable experimental evidence of the rate of formation of SO_3 from SO_2 in the presence of moisture and catalytic particles, and Dr. Mary Amdur has produced evidence of enhancement of SO_2 toxicity by the presence of NaCl aerosols of small average particle size. But there are numerous theoretically possible interactions among SO_2 and the assorted organic and inorganic free radicals believed to form in polluted air during irradiation.

Dr. Amdur's work has also shown the possibility that some species of aerosols influence the toxicity of some kinds of gaseous pollutants. Another function of aerosols, suggestd theoretically and supported by the experiments of Prof. Jack G. Calvert and associates at Ohio State University, is the possibility that specific kinds of airborne particles act catalytically to a significant degree in the photochemical system.

Effects of Specific Pollutants

Prolonged dosages at low levels of concentration of highly reactive oxidants, free radicals, and condensation products of the photochemical reactions of organic compounds are strongly suspect in various chronic and acute diseases of the respiratory system. Which are culpable, if any? At what levels of concentration do they cease to be troublesome over long periods of exposure? Do they produce or predispose to carcinomas of the lung and other sites? Does long exposure to any of them at some level of concentration affect longevity, work efficiency, or general well-being? Do any of them, specifically or in combination with other circumstances, affect respiratory or other restrictive systematic impairments? All these questions need to be answered.

Analysis

For a long time in the future, the tools available will limit the understanding of atmospheric reactions and their products, the effective monitoring of pollutant levels, and useful pollution surveys. Instrumentation and analytical methods for air pollution work need to be inexpensive, simple, direct, and specific in principle and in operation. New and cheaper methods for establishing patterns of pollution movement in all three dimensions of the air reservoir will be essential for regional zone planning.

It is reasonably suspected that, of the numerous measurements habitually incorporated into air pollution surveys, only 1 or 2 give information fully as useful as that obtained by collecting all the measurements in any given local situation. One of the most pressing immediate needs is the provision of bases for selecting 1, 2, or 3 simple, direct indexes of pollution related to identifiable patterns of pollution sources.

These subjects for research could certainly be extended into the engineering control of sources of pollution. As technological changes occur in manufacturing processes, transportation, and commerce, a continual procession of new abatement techniques will be demanded and developed.

The Next 50 Years

Much less certain, however, are the major air pollution concerns of the next half century. The following suggestions are based on a few indications of what seems destined to affect the air supply or improve our capability for cleansing it.

Pollution by radioactive chemicals. A considerable body of opinion insists that the airborne products of nuclear fission and fusion processes are endangering the health of present and future generations. Nothing foreseeable will prevent the continued exploitation of atomic energy for peaceful or military purposes. Inevitably, local and worldwide prob-

lems of pollution by radioactive byproducts will increase in frequency and intensity.

Meteorological control of local air pollution. Significant strides toward long-range weather prediction have been made during the past 20 years, and some progress toward local modifications of meteorological phenomena has been reported. Our imminent capability for satellite observation of air movements and the availability of nuclear energy makes it worthwhile to consider modifications of regional meteorology to assure more adequate air movement.

Effect of air pollution on world climate. Some evidence has been advanced that combustion processes are adding CO_2 to the atmosphere so rapidly as to cause accumulation in spite of the water reservoirs with which this gas must be in equilibrium. A significant change in CO_2 level in the air could, in theory, produce profound effects on world climate. Worldwide monitoring of CO_2 concentrations, an International Geophysical Year project, might well be continued.

Jurisdiction in air pollution control. Many of these situations imply the extension of air pollution study and control beyond local, State, and national jurisdictions. Already a need has appeared in a few regions to establish acceptable procedural and survey patterns that will permit authorities to act jointly. Preparation for concerted action among governments will be essential to effective application of technological principles.

The problems we face are increasing in some exponential relationship to national and world populations. Almost all the environmental factors demanding attention are of two kinds: those involving competition for finite amounts of the materials required for human existence, and those resulting from the accumulation of byproducts of the human utilization of such substances.

Thus air, water, and basic nutritional, industrial, transport, and energy requirements become the foci of efforts to maintain health, reasonable living standards, and some comfort in the face of an exploding population. Sooner or later health agencies will have to face the fact that 600 million people cannot live well in the waste products of resources capable of sustaining half that number.

Food Technology

brief

Food processing and distribution is about an $80 billion industry, the largest in this country. Concomitant with the industry's growth there has emerged a need for further information about the effects of processing upon food.

The food processor today is well aware that he must consider the factors of color, flavor, texture, convenience, stability, aesthetics, nutrition, and safety, all of which influence consumer acceptance.

To maintain or obtain the desired color it is at times necessary to use particular processes or chemicals. Fundamental work on natural colors and the various processing treatments influencing them is greatly needed. Intensive studies are being conducted on the nature of flavor and the effects of various processes and storage conditions.

In recent years convenience has received more attention than any single factor in the processing of foods. In many foods convenience has dictated the use of a great variety of chemicals and new processing techniques and the mixing of various food components. A large amount of work remains to be done on the stability, safety and nutritional properties of these products.

Other Consumer Influences

Stability, or shelf life, is extremely important in all foods, for practically none are imperishable under adverse temperature conditions. Deteriorative changes resulting in loss of flavor, color, texture, and nutritive value occur very commonly during storage. At State food conferences being held to encourage better nutrition, much is said about variety in the diet and proper nourishment, but nothing is heard about storage deterioration and its possible effect on nutrition.

These deteriorative changes may also be important from the standpoint of safety. There is some evidence that the chemical products re-

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Based on a paper by Emil M. Mrak, chairman, department of food technology, University of California, Davis.

sulting from such changes can be harmful and some may affect appetite. The need for research in food stability during storage is apparent.

The aesthetic values of foods are a major consideration. While insect contamination is probably not harmful, it is repugnant and chemical fumigants are used to control it. There should be sufficient data to support the view that these fumigants are safe.

The nutritional value of foods is of prime importance. Consumers generally believe that fresh products are far superior to canned, frozen, or dried foods, yet we know that fresh products can deteriorate very rapidly in acceptability and nutritive value. Because of improper harvesting, distribution, and handling of fresh foods, I would not be surprised to find that, on the whole, processed foods have better vitamin retention than the fresh.

Food processors must be careful about chemical residues, insect fragments, and other such items in their products, but relatively little attention is given to these in marketing fresh produce. There is a need for extensive studies on the acceptability, nutrition values, and general quality of fresh produce.

Changes in Processing

Great changes are taking place in canning procedures. The so-called short high-temperature procedure is receiving more consideration because of a possibility of increasing case yields, faster operation, and better color and flavor. However its relationship to storage stability, nutritional value, and acceptability of the produce is not completely known.

The rapidly increasing rate of production of frozen foods, particularly precooked or partially cooked dishes, makes it improbable that an adequate study has been made of the changes in microflora that occur during this type of processing.

Concentration of foods by the use of a vacuum at relatively low temperatures is now a common processing procedure. However, a great deal is yet to be learned about its effect on enzymes, chemical changes, microbial survival, and vitamin retention.

Circumstantial evidence indicates that foodborne infections are fairly common, but to my knowledge the amount of work being done to investigate them is limited. How extensive is salmonellosis? Are staphylococcus infections increasing? Would not a thorough understanding of the causes of these infections and the development of control procedures be better than prescribing drugs after infections?

Today most of our foods are packaged. The Food and Drug Administration insists that safe materials be used in packaging; nevertheless we need to know how these materials may affect food.

The food industries are mechanizing as rapidly as possible even though the effects of mechanization on acceptance, nutritive values, and storage characteristics are not completely understood. For example, the bulk handling of cling peaches from the farm to the consumer is almost a reality, yet we do not know the results such handling will have on the fruit. Last year transporting peaches in water in plastic containers was tried. Those in the containers for 6 hours had a low acceptability because of off flavors.

If we are to give the consumer canned peaches that are perfectly safe, with highest vitamin content and best color and flavor, it is important to know what happens between the orchard or processing plant and the consumer. Quite possibly some treatment during processing may adversely influence storage of the product, causing a loss in nutritional value or color or even the production of compounds resulting from deterioration.

Food should be considered from the time the seed is planted, the egg is laid, or the animal born, until it is consumed. So much can happen to food as it passes through various stages, and any one factor may so markedly affect it, that nothing can be overlooked.

The National Conference on HOSPITAL-ACQUIRED Staphylococcal Disease

THE NATIONAL CONFERENCE on Hospital-Acquired Staphylococcal Disease was held in Atlanta, Ga., September 15 to 17, 1958, under the joint sponsorship of the Public Health Service and the National Academy of Sciences-National Research Council.

The conference brought together delegates from 59 professional organizations and specialists from universities, independent laboratories, and hospitals.

In the opening address, Dr. Leroy E. Burney, Surgeon General of the Public Health Service, underscored heavily the importance of blocking hospital-acquired staphylococcal disease from invading the public environment. The threat, he said, "involves the development of antibiotic resistance and emergence of specific epidemic strains, with the concurrent threat to hospital populations and the community at large."

Other highlights of his address follow:

"Staphylococcal disease has rarely presented itself in modern times as a public health problem requiring an organized community attack, and not until now as a problem of national significance and growing magnitude. Only recently have the several professions involved in medical, hospital, and public health services begun to understand the dynamics of staphylococcal disease and hence to recognize our dependence upon one another for its control.

"We in the United States . . . must give the palm to our medical and public health colleagues in the United Kingdom, Canada, and

Australia for the first isolation of antibiotic-resistant strains in hospital populations, the development of bacteriophage typing as a new tool in staphylococcal research, and for the first demonstrations of the epidemiological patterns of hospital-acquired staphylococcal disease.

"The Symposium on Staphylococcal Infections sponsored by the New York Academy of Sciences in February 1956 brought together for the first time in this country much of the existing knowledge of the twin problem of antimicrobial resistance and staphylococcal infections in hospitals. Shortly thereafter, epidemiological studies began to appear, showing not only the nationwide prevalence of resistant strains in hospital populations, but the spread of such hospital-acquired infections into local communities.

"Since then, concern has mounted in research, clinical, and public health circles. In October 1957, for example, the Association of State and Territorial Health Officers recommended that the Public Health Service seek funds to expand its technical assistance to the States on staphylococcal problems.

"In December, the American Hospital Association, through its Council on Professional Practice, appointed a Committee on Infections Within Hospitals. This committee consulted with the Joint Commission on Accreditation of Hospitals and with the Public Health Service concerning staphylococcal infections and in May 1958 issued a bulletin recommending action in hospitals and local communities. Earlier in the year, the American Academy on Pediatrics, through its Committee on the Foetus and the Newborn, issued a supplement to its standards for the management of premature and newborn nurseries, calling for special attention to staphylococcal infections.

"For the current fiscal year, Congress appropriated $325,000 to the Public Health Service for the Communicable Disease Center's laboratory services, training, investigations, and epidemic aid in staphylococcal disease, and added $1 million to our research appropriations for the expansion of staphylococcal research through National Institutes of Health research grants.

"Last April, I asked the American Hospital Association's Committee . . . to advise me on this problem of national action. What are the immediate needs? And how can the Public Health Service best help to meet them? These consultants agreed that:

"First, knowledge of the existing problem of staphylococcal disease and the means for its control needs to be consolidated and brought home to the medical and health professions at all levels as quickly and as impressively as possible. A national conference should be called to develop a practical plan and to stimulate State and local action.

"Second, a complete review and careful expansion of staphylococcal research should be undertaken. In this area of need, the National Institutes of Health has been busy.

"The third need expressed by my consultants was for expansion of services to assist hospitals in preventing and controlling staphylococcal disease. This cannot be done, we all know, without high-quality bacteriological and epidemiological services and very few hospitals have such services intramurally. Laboratory

New Agents Counter Staphylococcus

Two antibiotics were reported to be apparently effective against staphylococcal strains, at the Sixth Annual Symposium on Antibiotics, October 1958 in Washington, D. C. In 2 years of clinical trials of vancomycin, no resistant staphylococcus bacteria were encountered, according to Dr. M. M. Kirby and two colleagues of the University of Washington. They added that in 30 patients who were administered the drug in the last year results were dramatic in instances where other antibiotics had failed.

Another antibiotic, kanamycin, was presented as a highly effective bactericidal agent with a broad spectrum by researchers at the University of California and Wadsworth Veterans Administration Hospital. They described its use on 100 patients.

Also, Dr. Paul A. Bunn and Dr. Aldona Baltch of the State University of New York Upstate Medical School report in the *New England Journal of Medicine*, October 2, 1958, that kanamycin has been found "to have an inhibiting action against most staphylococci that are penicillin-resistant" in the treatment of 25 severe and acute infections in the adult.

identification of staphylococci, epidemiological consultation, epidemic aid, nursing consultation, and other services such as are common in State health departments—and through them, in the Public Health Service—will be needed in increasing volume as more hospitals begin to explore and control their staphylococcus problem.

"In this area, of course, the Communicable Disease Center is the Public Health Service's right arm. Staphylococcal disease has been given the highest priority throughout the Center. The laboratory, for example, has accepted responsibility for the National Reference Center for Staphylococcus Phage Typing. Diagnostic reagents are being prepared on a large scale by the Communicable Disease Center. Also, its Epidemic Intelligence Service physicians and nurses have been working full time on epidemiological studies in response to increasing requests for help. Training courses for laboratory workers are being developed and a wide variety of new training aids are being prepared. We expect that all of these services will be expanded rapidly as the national program gains momentum."

As the conference progressed, the participants scanned all facets of the hospital-acquired disease. They took inventory of current knowledge by presenting papers during general sessions, and by open discussion in three small groups, assigned respectively to nursery, surgical, and general medical activities in the hospital. Finally, the delegates framed a set of recommendations which Dr. Burney hoped would be "accepted as 'marching orders' for every group concerned with sick and healthy people in this campaign against staphylococcal disease."

Appearing in this issue of *Public Health Reports* are the conference recommendations, Dr. Harry F. Dowling's résumé, and a paper on the community aspects of hospital-acquired staphylococcus infection by Dr. Frederick H. Wentworth and associates. Dr. R. E. O. Williams' report on the staphylococcus situation in Great Britain appeared in the November 1958 issue, p. 961.

The full proceedings of the conference were published in October 1958 by the Communicable Disease Center for distribution to hospitals, medical societies, and health departments.

Synthesis of Recommendations

General Recommendations

The conference accepts hospital-acquired staphylococcal disease as a serious problem of global scope. There are major difficulties in comparing the incidence of infections now being observed with that in previous years, but it is generally accepted that convincing evidence establishes the problem as a serious one and that definite action on the part of hospitals and other community agencies is imperative.

Communications

Infections Committees

It is unanimously agreed that the establishment of hospital infections committees is a sound approach to the recognition, prevention, and control of hospital-acquired staphylococcal disease. The conference endorsed the recommendations of the American Hospital Association and the Joint Commission on the Accreditation of Hospitals. The following recommendations concerning the composition, responsibilities, and mechanisms of operation of such committees deserve special emphasis.

Composition

The hospital infections committee should consist of active, interested members of all major hospital departments, including administrative, clinical, nursing, housekeeping, and laboratory. The committee must have complete administrative backing. The chairman or coordinator of the committee must be a person of stature. It is generally agreed that the bacteriology laboratory is the area through which most information about infections should be channeled. It is recommended that a bacteriologist, pathologist, or clinician with interest in bacteriology, be a permanent member of the committee and that he or some individual be charged with maintaining the day-to-day record of infection. This person should serve as hospital epidemiologist.

It is recognized that the composition and size of the committee will vary considerably from hospital to hospital, depending upon their physical and personnel resources. The committee should make free use of small subcommittees of key people for specific assignments. It is also recommended that the local health

officer should be invited to be a consultant to the committee.

Responsibilities

The hospital infections committee should have the following major areas of responsibility:

Surveillance. The committee should regularly collect complete data on all infections acquired within the hospital, on those occurring among recently discharged patients, and determine the presence of a problem, if one exists. These data should be consolidated into formal reports for submission to the medical staff and the hospital administrator.

Control. The committee should be charged with the responsibility of evaluating all phases of hospital operations pertaining to the control of infections, recommending changes, establishing appropriate patterns of antibiotic usage, and instituting epidemic control measures.

Nevertheless, this committee should in no way relieve the department heads of responsibility for making decisions and executing recommendations with reference to particular department problems.

Education. The committee should sponsor an educational program for all hospital personnel, presenting current concepts in the proper prevention and control of hospital-acquired infections.

It is recognized that the effectiveness of any system for dealing with hospital-acquired infections will depend upon a continuing, active program directed to all professional and nonprofessional groups.

Mechanisms of Operation

Mechanisms of operation will vary considerably in the individual institutions. Frequent and regular meetings of the committee are essential to maintain a high level of interest. One of the measures of effectiveness of the committee will be the thoroughness with which advice is implemented into action. Determination of the effectiveness of the committee should rest primarily with the committee and the medical staff, and not with possible inspecting agencies.

Ample emphasis should be placed on surveillance, since the major defect in delineating the staphylococcal problem is the lack of uniformity in recognizing and reporting staphylococcal disease. Of the several methods of surveillance considered at this conference, routine culturing of all infections received the most support. In applying this method, culture results are routinely reported to the hospital infections committee for investigation, review, and classification. The final classification of each case should include the committee's determination as to whether or not the infection was acquired in the hospital. Surveillance of this type may be facilitated by the utilization of a standardized reporting form.

Interhospital

Because patients acquiring infections in one hospital may subsequently be admitted to another and because of the frequent interchange of personnel among hospitals, interhospital communications are essential to infections control. Such communications might be developed by establishing infections committees in the local medical societies, with representatives from the hospitals in the area. Interhospital communication might also be achieved by the addition of members of the staffs of other hospitals to the membership of the hospital infections committee.

Health Department

The health department can be of considerable help to the hospital in controlling infections by providing laboratory services, epidemiological consultation, and assistance with surveys of illness among discharged patients. To attain optimal communications between hospitals and health departments, the health officer should be made a consultant to the hospital infections committee.

Official Reporting

Official reporting of staphylococcal diseases is difficult because of the ubiquity of minor community-acquired staphylococcal infections. No specific recommendation concerning voluntary or compulsory reporting of staphylococcal diseases is made. Some delegates felt, however, that mandatory reporting of staphylococcal disease during the first 6 weeks of life might be helpful. Diseases in this age group to be reported might include pyoderma, breast abscess, empyema, and osteomyelitis. Other conferees feel that it is feasible to report all staphylococcal infections provided the reporting forms are simple. In some States, staphylococcal disease is now notifiable. The reporting programs of these States warrant careful evaluation.

Patient Care

Admission Policy

It is known that some patients are more susceptible to staphylococcal disease than others. Since hospitals may represent a significant reservoir of staphylococcal infections, individual hospitals should reconsider their admission policies regarding highly susceptible patients. In many instances, these patients might be better managed in the home.

Patients with staphylococcal disease requiring hospitalization should be recognized as a potential danger and proper precautions instituted at the time of admission.

Isolation

Infected patients are a major source of hospital infections. Ideally, all infected patients should be placed in strict isolation. This ideal is often unattainable. Priority then should be given to isolating those who are most likely to spread infection to others; for example, patients with pulmonary staphylococcal infections or with exposed foci of suppuration. In addition, it is advisable to isolate certain patients who are especially susceptible to staphylococcal infections, such as those with extensive burns or exfoliative dermatitis.

The transportation of patients with staphylococcal infections from one area of the hospital to another, while often necessary, may be dangerous. It is recommended that these patients be covered with sterile sheets during transport. Careful cleaning and disinfection of the areas in which they have been examined or treated should be a routine procedure.

It is becoming increasingly apparent that techniques of isolation have fallen into disuse and are unfamiliar to both professional and nonprofessional personnel. Consequently, as practiced, they are often ineffective. It is strongly recommended that the hospital infections committee carry out continuing programs of education in isolation procedures. (See the section on hospital sanitation for recommendations on sterilization, disinfection, and hospital design).

Diagnosis and Therapy

Certain techniques formerly considered minor, such as venipuncture, intravenous cannulation, clysis, catheterization of the urinary bladder, and aspirations of body cavities, indeed all procedures which interrupt the normal skin barrier, may produce important portals of entry for staphylococcus infections. It is recommended that these procedures should be kept to a sensible minimum and always be performed with strict asepsis.

The conference considered both the general problems of antibiotic therapy within the hospital and the application of antibiotic prophylaxis to the control of infections.

General Antibiotic Usage

There was unanimous condemnation of the indiscriminate use of antibiotics and acceptance of the need for plans to govern their judicious usage. No single plan has yet been found to be satisfactory for application in all types of hospitals and therefore specific recommendations cannot be made. It is urged, however, that hospital infections committees give priority to a study of this problem and design an orderly approach to meet their own needs.

Antibiotic Prophylaxis

With certain exceptions, antibiotic prophylaxis to prevent staphylococcal infections has not proved to be a useful or desirable procedure, and it is not recommended.

One exception to this recommendation may be made in the nursery epidemic situation where antimicrobial prophylaxis against the specific epidemic strain may be the method of choice for the interruption of an epidemic (see Specific Recommendations, Nursery). Other exceptions may be made for certain types of patients who are at special risk. In these cases, antibiotics should be used only after careful deliberation by a group or committee concerned with the problem.

It is unanimously agreed that prophylactic antibiotics do not prevent staphylococcic infections in clean surgical wounds, but that they may tend to mask or attenuate the appearance of the infections. It should be emphasized that the most important points in surgical wound management, whether the wounds are operative or traumatic, are asepsis and meticulous, careful technique, combined with the removal of all devitalized and contaminative foreign material, and closure of tissues with maintenance of an adequate blood supply.

Hospital Sanitation

The widespread occurrence and hardy nature of the staphylococcus stimulated considerable discussion of the importance of high standards of environmental sanitation. The recommendations are grouped into those concerning hospital design, ventilation, housekeeping procedures, and sterilization and disinfection.

Hospital Design

Basic to the effective application of aseptic technique is the provision of proper equipment and space allocation for their implementation. Certain deficiencies in hospital design are becoming apparent, but because present knowledge does not permit definitive recommendations about changes in hospital architecture, caution must be exercised before undertaking extensive building alterations in the hope that they might limit staphylococcal disease within hospitals.

On the other hand, it is recommended that hospital administrators seriously consider such alterations as are necessary to bring existing facilities up to standards currently recommended by the American Academy of Pediatrics, the American Hospital Association, and State and local health departments.

In addition, scientifically controlled research studies should be conducted to determine, for example, the optimal design for newborn nurseries and to demonstrate the validity of minimum standards currently recommended for the elimination and control of cross-infection.

Hospital Ventilation

Cognizance was taken of the many studies describing a reduction of the concentration of bacteria in the environment following the installation of various types of ventilation equipment. It is agreed, however, that these methods have not been adequately evaluated in terms of their specific effect upon the prevention of infection. No recommendations concerning changes in existing ventilating systems were made, but it was suggested that proper cleansing and maintenance of air conditioning systems now in operation should be a routine hospital housekeeping procedure.

Housekeeping Procedures

There is growing evidence that poor housekeeping techniques contribute to the dissemination of hospital-acquired staphylococcal infections. It is agreed that effective housekeeping demands constant vigilance on the part of both the administrative and professional staff and can be effectively accomplished only when all groups give due recognition to this aspect of disease control. It is recommended that the hospital infections committee periodically evaluate all parts of the housekeeping routine, giving special attention to adequate dust control, acceptable techniques of floor cleaning, sterilization of equipment, and laundry procedures.

As recent studies have focused attention on the laundry and its role in the dissemination of infection, it is recommended that great care be given to insure that contaminated linen and blankets, particularly from patients with staphylococcal disease, not be mixed with other laundry, that contaminated trucks not be used for transporting clean laundry, and that clean and dirty laundry never be transported concurrently. Evidence suggests that

sheets, blankets, and mattresses may play a role in the spread of infection, and thus deserve special attention.

Patients admitted to the hospital should be furnished with clean blankets, sterilized linens, and clean mattresses. Cleanliness of mattresses may be approached through the use of disposable or nondisposable plastic covers.

Sterilization

Because sterile technique is so fundamental to the prevention of hospital-acquired staphylococcal disease, techniques of sterilization and disinfection require constant attention and reevaluation. Meticulous checks, both thermal and bacteriological, on the effectiveness of ordinary methods of sterilization should be routinely carried out. The need for sterilization of certain kinds of equipment, such as stethoscopes, ophthalmoscopes, and sphygmomanometers, should be reconsidered.

Personnel Carriers

Carriers of staphylococci among hospital personnel present one of the more difficult problems in the control of hospital-acquired staphylococcal infections. There are really two problems here. The first is the individual with a frank lesion, the other is the inapparent carrier who is without overt lesions.

Frank Infections

It is strongly recommended that hospital personnel, including physicians, nurses, and others, who develop frank staphylococcal lesions should be excluded from duty until the lesions are healed. It is further recommended that:

- A continuous program of education of all personnel emphasize the hazard of staphylococcus lesions to the welfare of the patient.
- Personnel be required to report the presence of lesions to a central clinic or to a designated physician.
- All reported lesions receive prompt diagnosis and therapy.
- A policy be adopted to prevent financial loss to personnel who are barred from duty because of frank lesions.
- During an epidemic or period of increased incidence of staphylococcal disease, active search be made for the presence of lesions among the personnel. Such a program can be appropriately directed by the infections committee. In searching for carriers, a thorough physical inspection should be made to detect those who may have hidden but dangerous lesions; for example, in the axilla, buttocks, and perineal region.

The Inapparent Carrier

The majority of hospital personnel may be shown at one time or another to be carrying coagulase-positive staphylococci on their skin or mucous membranes. It must be stressed that most of these carriers are not hazardous to the patients, because they either disseminate very few staphylococci or the particular strain of organism which they are carrying is of low transmissibility or pathogenicity, or both. The mere presence of coagulase-positive staphylococci, therefore, is not grounds for removal of a carrier nor does it constitute an indication for antibiotic therapy. Thus, routine surveillance for carriers is not recommended.

During an epidemic or increased incidence of disease, it is essential that a thorough search of all personnel be made for carriers of epidemic strains associated with the outbreak. The usually accepted method for finding carriers is restricted to nasal or nasopharyngeal culture surveys of the personnel. In instances where carriers of epidemic strains are not found by this technique, it might be helpful to extend the examination of personnel to other potential portals of exit, such as the hair, throat, perianal skin, and stool.

Carriers of epidemic strains associated with the outbreak should be considered "dangerous carriers" and should be removed from duty. Many carriers, even the temporarily dangerous ones, will cease to carry the epidemic strain upon their removal from the contaminated environment. The status of the individual carrier must, therefore, be periodically evaluated and after his reversion to negative, he should be returned to duty.

When an epidemic strain persists in a carrier, his permanent removal from duty must be given careful consideration. Such victims should receive assistance in the form of new job training.

Many substances such as antibiotic nasal jellies and sprays have been used both for the prophylaxis and for local treatment of carriers. The conference is unable to recommend any of these procedures at the present time but urges their evaluation.

Specific Recommendations

In addition to those recommendations which apply generally to the detection and control of hospital-acquired staphylococcal disease within the hospital, the conference has made certain recommendations which apply specifically to a particular service within the hospital.

Nursery

Discharged Infants

It is characteristic of staphylococcal disease in newborn nurseries that the vast majority of infants do not develop lesions until after they have been discharged from the hospital. In order that the hospital may become aware of a staphylococcal problem within the nursery as early as possible, some method needs to be devised for detection of infections among the discharged infants. Several methods have been used for this purpose: telephone surveys, questionnaire surveys, routine visits by public health nurses, or culture surveys of infants at the time of discharge. The conference generally recommends the telephone survey as being most desirable in epidemic situations because of its efficiency, promptness, and ease of administration. However, all of the methods enumerated have been shown to be effective in some communities, and the hospital infections committee should decide which one to use after consultation with other community

agencies, especially the medical society and health departments.

It is generally recommended that surveys of discharged infants be carried on by the hospital, but it is recognized that in many communities the health department can assist with or can conduct the survey.

Surveys of this kind can obviously be conducted on either a periodic or continuous basis. Some hospitals carry on continuous surveys as part of their general disease surveillance program. Other hospitals conduct periodic surveys. Often a routine sampling of a portion of discharged patients is satisfactory. It is strongly recommended that all hospitals institute some type of survey procedure.

Antibiotic Prophylaxis

In some instances, nursery epidemics appear to be self-propagating and result in a high incidence of colonization or frank disease among the infants due to an epidemic strain of high virulence. In such situations, it is possible to protect infants from colonization by administering an effective antibiotic in full therapeutic doses to all infants beginning immediately after birth and continuing until after discharge. Antibiotic prophylaxis of this type effectively prevents colonization of the infant's nose and thus his skin and allows time to search for dangerous carriers among the personnel, and to locate and correct breaks in aseptic technique. Antibiotic prophylaxis should be used only after very careful evaluation of the situation, preferably by the infections committee, and should never be used for prolonged periods nor be used on a continuous basis.

Periodic Culturing

Available evidence suggests that specific strains of staphylococci which can be detected by phage typing are capable of producing nursery epidemics. In contrast with the other services in the hospitals, therefore, it may be profitable to survey the nursery personnel periodically in order to detect carriers of these particular strains. Such surveys should be undertaken routinely only in well-equipped hospitals and should be considered as combined research and control procedures.

Surgery

Operating Rooms

Separate operating rooms for clean and "dirty" surgical cases are not recommended. Rather, all operating rooms should be cleaned between operations and meticulously so after an operation on a contaminated case. The same meticulous care must be applied to sterilizing contaminated linens, instruments, and operative clothing.

Scheduling of Operations

It is recommended that "dirty" surgical cases be placed at the end of the operating schedule.

Operating Room Technique

The entire operating room team must be constantly alert for breaks in technique. Excessive talking (chatter) has no place in the operating room. Operating room clothing must not be worn outside the operating suite. Caps and masks must be changed between each operation. All visitors to the operating room must change completely from street clothing before entering.

Surgical Dressing Technique

Every effort should be made to minimize cross-infection through contaminated dressing carts and faulty dressing care.

Personnel Carriers

Personnel found to be carriers of coagulase-positive staphylococci of any type should be allowed to continue on duty in the absence of an increased incidence of surgical wound infections. Even when a problem does exist, the removal of carriers should be delayed until one is certain that all other possibilities, such as defects in sterilization, have been ruled out. The one exception to this general policy is the nurse or physician who is known to be a carrier of an epidemic strain and comes from a service where there has been or is a problem.

While these recommendations apply to the inapparent carrier, it is strongly recommended that all personnel with frank staphylococcal lesions remove themselves from the surgical suite until the lesion is healed.

Medical Services

Distinct differences in the pattern of staphylococcal infections on medical services as contrasted with surgical and pediatric services are recognized. Nevertheless, it is agreed that a substantial staphylococcal infection problem exists on medical services also and the need for constant attention to aseptic techniques and control measures is just as imperative here as elsewhere. This need is important not only to prevent infections among medical patients, but also because of extensive commingling of patients among services to control spread of disease throughout the hospital.

Laboratory Services

Initial Isolations

Bacteriological services of a high caliber are essential to the diagnosis and therapy of staphylococcal disease and to the detection and control of hospital-acquired staphylococcal infections. It is recommended that hospitals throughout the country include in their laboratory programs the initial isolation of staphylococci, coagulase testing, and antibiotic sensitivity testing. It is recognized that there is presently a certain amount of unreliability with the disk method of antibiotic sensitivity testing, but it is noted that the Food and Drug Administration is presently adopting standards in an effort to correct these defects. While the serial tube method is admittedly more accurate, it is considered to be too time consuming and expensive for routine use. Therefore, most hospital laboratories must resort to the disk method for establishing the antibiotic sensitivity of staphylococci.

Specific Diagnosis

Bacteriophage typing is not practical in most hospital laboratories at the present time, but specific diagnostic services should be available when needed. While there is little routine need for such serv-

ices, they are essential to the detection of sources of nursery epidemics and their control; and are helpful in the control of outbreaks or in other services. However, it is strongly recommended that hospital laboratories adopt some systematic method of saving isolates of staphylococci from infected individuals, so that in the eventuality of an outbreak, it will be possible through bacteriophage typing to trace the events that led to the epidemic. Policies concerning the length of time cultures should be saved and the selection of strains for bacteriophage typing can appropriately rest with the infections committee.

Special Recommendations

In addition to the recommendations which have been made for the hospital and hospital services, the conference has made certain special recommendations concerning the provision of certain services and the request for assistance from certain agencies.

Terms and Classification

An ad hoc committee on the terminology and classification of staphylococcal disease should be established. It is agreed that considerable confusion exists because of the lack of agreement in the use of such terms as apparent and inapparent infections, disease, sepsis, clinical or subclinical infection, and asymptomatic carrier. Many difficulties result from attempts to compare data in published reports that fail to distinguish the carrier state from colonization and disease or sepsis. It is strongly recommended that a subcommittee be formed to define terminology that will clearly differentiate these various terms and clarify the vocabulary applicable to staphylococcal diseases.

In addition, the committee should be requested to provide a classification and grading of infections which could be used as a guide by individual hospitals in their surveillance programs.

Education and Training Aids

The conference recognizes the need for education and training aids to support the national program necessary for the control of staphylococcal infections in hospitals. It is strongly recommended, therefore, that the chief of the Communicable Disease Center ask appropriate interested organizations, including the American Hospital Association, the American Medical Association, and the American College of Surgeons, to designate representatives to form an interagency clearinghouse or coordinating committee for educational materials, such as audiovisual aids and literature. Such a committee, by joint sponsorship, would encourage the production of the best possible material, would avoid unnecessary duplications, and would keep all concerned aware of activities in this field.

Methods Manual

Although much useful information regarding adequate sterilization and disinfection procedures has been published, it is currently scattered in many relatively inaccessible publications. It is recommended, therefore, that all available information on sterilization of special equipment, environmental disinfection, and the most recent methods of sterilization be collected in readily available manual form and distributed by the Public Health Service or some other appropriate agency.

Hospital Ventilation

Because aerial dissemination of infection may play an important role in the transmission of hospital-acquired staphylococcal disease, there is a need for a correlation of information by the medical, epidemiological, and engineering professions. Therefore, the Public Health Service is encouraged to arrange a conference of interested representatives of these professions to examine the whole problem and develop sound standards.

Laboratory Manual

Attention is called to the fact that the Communicable Disease Center Laboratory in Atlanta, Ga., has recently assumed the responsibility of providing reference laboratory services for bacteriophage typing. A manual of acceptable procedures for the precise identification of staphylococci has been produced with the assistance of a subcommittee of this conference.

In Résumé

We have hammered out the many things that we know and that we do not know about staphylococci. We know the cultural characteristics of the organisms, their prevalence in hospital patients, hospital personnel, and persons outside of hospitals, and the frequency with which they are found in the hospital environment. We know how, roughly, to determine whether a strain is potentially pathogenic, how to identify individual strains, and how to trace their spread from person to person. We do not know how to determine the invasiveness of an individual strain, nor its pathogenicity, with certainty, nor its virulence. We do not know how to prevent the spread of staphylococci from one part of a person's anatomy to another, nor from one person to another person.

We know the prevalence of strains of staphy-

lococci which are resistant to various antibiotics in different populations, and we know some of the factors that cause resistant strains to appear; we don't know how to prevent the appearance of such strains in hospitals (short of exposing no one at all to that particular antibiotic), and we don't know how to replace a resistant strain with a sensitive one.

We know that staphylococci are spread among patients and personnel of hospitals, that they may cause endemic infections in any hospitalized patients and epidemics chiefly among newborns and surgical patients. We don't know the most frequent pathways of spread, whether carriers or environmental sources are the most important, nor what makes epidemics start. We know that certain strains are more frequently encountered as epidemic strains; we don't know what causes them to become epidemic strains. We can often trace an epidemic to an infected person or carrier; we cannot tell why some other infected person or carrier did not start an epidemic. We know that the removal of a carrier or strict attention to aseptic techniques sometimes appears to stop an epidemic; we fear that these measures will not always do so.

We know some conditions that increase patients' susceptibility to staphylococcal infections, but do not know why some persons develop staphylococcal infections while others fail to do so under apparently identical circumstances. Finally, especially as a result of this conference, we don't know any cause for wild alarm and gnashing of teeth over the staphylococcal problem; we do know that there is an important and compelling job to be done which calls for rolling up our sleeves and getting to work.

Techniques of Control

How should we go about controlling staphylococcal infections? Since we cannot easily get rid of the staphylococci that are causing or may cause disease within a hospital, most recommendations in the discussions were directed at limiting their spread. The first barrier is at the entrance of the hospital or the ward. Perhaps some patients with staphylococcal infections could be better nursed at home. Hospital personnel, from the chief of staff down, should not contact patients if the staff member has a staphylococcal skin lesion or is known to have produced infections in patients. During an epidemic in a critical area such as a nursery or an operating room, personnel may be removed if they are carrying the epidemic strain.

The second barrier is within the hospital, between personnel and patient or between patient and patient. The conferees unanimously recommended complete isolation of patients with staphylococcal infections, wherever practicable. They urged that careful techniques be observed in the performance of operations, along with the proper sterilization of instruments and apparatus, the proper technique in dressing wounds, careful disposal of discharges and sputum, the washing of hands after examining patients with infected lesions, and the removal of staphylococci from that susceptible animal, the newborn infant, by washing his skin with special preparations.

With regard to spread through the air or from objects in the environment, everyone recognized the need for more knowledge. We do not know enough about the importance of proper ventilation (except in the operating room and rooms for dressing wounds), of washing floors and walls, of sterilizing blankets, of spacing beds and cribs; we do not know the value of rooming-in procedures for infants and so on. It was emphasized again and again that there is no simple and easy panacea for the control of intrahospital staphylococcal infections. Many things must be done, some of which may be unnecessary; the wisest course is first to close the most likely pathways of spread of infection and proceed to the others if necessary. In the last extremity, nurseries or wards may be closed, and, almost everyone agreed, the operating room might have to be closed, too.

Antibiotics, which have no doubt been responsible for some of our trouble with the staphylococci, are of little help in getting us out of trouble. Their role in the prevention of infections is limited to certain specific situations. There is no evidence that they will prevent staphylococcal infections from developing in hospitalized patients except perhaps

when the staphylococcus causing an epidemic in a nursery is sensitive to a specified antibiotic. The surgeons even differed as to whether the poorly absorbable antibiotics should be administered prior to bowel surgery, although they did agree that antibiotics will not prevent infections from developing in clean surgical wounds. The suggestion was made that spraying of the noses of carriers may eliminate the carrier state in some persons, but it was recognized that more study is needed in this area.

Of course, a most important means of control is to eliminate the infection at its source, in other words, to treat the patient who has a staphylococcic infection. This requires the highest degree of skill and knowledge on the part of the clinician to diagnose the disease properly, to interpret the tests run by the supporting laboratory, to choose the proper antibiotic from among the number at hand today, and to administer it properly. When the clinician is not sufficiently familiar with this area, he should not hesitate to call for advice.

A Reporting System

Infections cannot be controlled unless we know that they are there. This requires reporting of staphylococcal infections by certain responsible parties within each hospital. The initial report has been made in different hospitals by house officers, nurses, or personnel in the hospital laboratory. Different methods may be feasible for different hospitals. Whichever one is used, the reports should go to an infections committee, which should be set up in each hospital. Such a committee should be broad in its interest, representative in its personnel, and of sufficient authority to make sure that its suggestions will be carried out.

Reporting should be amplified by checkups of susceptible groups, such as newborns, after they have left the hospital. Several feasible methods were suggested for these surveys. Most important is that they have the full cooperation of the hospitals, of the medical profession, and of the health officer.

Reporting and control are not successful without proper definitions. Agreement could not be reached on any one system of classification of staphylococcal infections. Accordingly, it was suggested that the Public Health Service set up a committee to recommend a proper classification.

None of the measures for control will have any effect without continuous, interesting, and authoritative publicity. Educational programs are needed within the hospital for all the personnel from the lowest to the highest. These can be aided by health authorities and local and national medical associations by the provision of information, teaching aids, and speakers, and the initiation of communitywide meetings from time to time.

Finally, and most urgently, we need more research on staphylococci and the infections they cause. I have already mentioned some of the things we need to know. Funds are needed for intramural and extramural research on the practical problems of staphylococcal infections, their communicability and control, and especially on fundamental problems of host resistance to the staphylococcus and how it may be strengthened.

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Hospital-Acquired Staphylococcal Disease and the Community

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HOSPITALS provide vitally needed services to practitioners of medicine and to the community at large. Anything which tends to disrupt hospital services or interfere in any way with their optimal function is of real concern to the community. Hospital-acquired staphylococcal disease can certainly decrease the efficiency of hospital operation by prolonging the patient's hospital stay, increasing the cost of medical care, and, in some cases, jeopardizing the patient's recovery. The community and community agencies may be expected for these reasons to be vitally interested in the control of the problem.

Recent studies of the epidemiology of hospital-acquired staphylococcal infections have established additional reasons for concern. It is now very clear that the hospital with an uncontrolled staphylococcal disease problem may act as a focus of infection for the community itself. It is also clear that many patients infected while in the hospital do not develop overt disease until some time following their discharge and thus the detection of the disease in the community becomes essential to the delineation of the hospital problem and its control. Evidence supporting these concepts is at the moment most convincing in the case of strain-specific staphylococcal infections acquired in hospital nurseries.

Two outstanding features of the epidemiology of nursery outbreaks have been the number of infants who develop the first signs of disease following discharge from the hospital and the frequency of postpartum breast abscess among mothers. Studies on the nasal flora of women on admission to the maternity service and at the time of discharge, as well as that of their infants, indicate the infants (*1*) are the source of the staphylococcus responsible for the breast abscesses. These studies also demonstrated that in the vast majority of cases transmission from infant to mother takes place in the home. These findings suggested the possibility of simultaneous or subsequent transmission to other members of the family and the establishment of endemic staphylococcal disease within the family group.

Colbeck, while studying nursery outbreaks in Winnipeg in 1949, found this to be the case (*2*). In the families of 10 infants born in an epidemic period, he demonstrated recurrent suppurative disease among family members during several months following the discharge of the infant and mother from the hospital. Staphylococci isolated from the lesions in family members appeared to be of the same phage type as that responsible for the nursery outbreak. In 1953 Kempe, reporting the family as a reservoir of childhood infections, includes an excellent description of family staphylococcal disease persisting over a 9-week period (*3*). More recently we have studied the families of

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26 infants infected with the epidemic phage type 80/81 during a nursery outbreak (*4*). During 5 months of observation about three-fourths of the mothers and one-third of the fathers and siblings were shown to be carrying phage type 80/81 in their nasopharynx on one or more occasions. Eleven of the 26 families were still infected at the end of the study. A variety of skin infections and subcutaneous abscesses occurred in about 40 percent of the infected mothers and fathers and 70 percent of infected siblings. Shaffer and associates have reported similar findings (*5*). At the end of the 18 months of his study, 9 of 20 families were still infected.

These investigations have provided convincing evidence that epidemic strains of staphylococci carried by infants at discharge are rather readily transmitted to family members, persist for long periods within the family, and are responsible for endemic staphylococcal disease within the family unit.

Further evidence that the nursery epidemics may result in an increased incidence of community disease has been provided by a comparison of families of infants born during epidemic and nonepidemic periods in the same hospital. In one recent study, investigations were made of 1,076 families of infants born during a nursery epidemic of 3 months' duration and 211 families of infants born during a nonepidemic period (*6*). In 25 percent of the families of epidemic infants one or more members of the family group had developed staphylococcal disease 1 to 5 months following the birth of the baby, while 3 percent of families of nonepidemic infants gave a similar history. Eleven percent of 3,975 family contacts developed disease during the epidemic period, while 0.8 percent of 506 family members developed a similar illness during the nonepidemic period. If an infection rate of about 1 percent is accepted as a rough approximation of the level of endemic community disease during this period, then the difference between this and a rate of 11 percent is an approximation of the magnitude of increase in community infection which resulted from the nursery epidemic.

If the magnitudes expressed here are reasonably accurate and representative, it follows that a significant increase in the level of community staphylococcal disease will follow uncontrolled type-specific nursery outbreaks. We are unaware of systematic studies of the transmission of epidemic strains from these hospital-associated families into the general community, but fragmentary evidence suggests this to be the case. Certainly the persistence of the strains within the family unit for such long periods make it likely that transmission to friends and relatives will eventually occur. In this event the "crude equilibrium between the public at large and the ubiquitous staphylococci" referred to by McDermott as appearing relatively stable in 1956 (*7*) might well be shifted in favor of the staphylococcus and result in an absolute increase in the level of endemic community disease.

It is difficult for one who has not observed family staphylococcal disease to be impressed with the seriousness of the situation. We observed one family whose infant was born in October 1954 in a nursery during an epidemic caused by phage type 80/81. The infant developed a few blebs prior to discharge and severe staphylococcal impetigo after he went home. Since then this family has virtually never been without staphylococcal disease in 1 or more of its 5 members. The father and 1 of the 3 children have been hospitalized for incision and drainage of abscesses. The two other children and the mother have had incision and drainage as outpatients. On three different occasions the entire family has been treated with antibiotics in an attempt to eradicate the family infection. It is conservatively estimated that the cost in antibiotics and medical care, exclusive of hospitalization, has been well in excess of $1,500. Type 80/81 has been repeatedly isolated from the nasopharynx and lesions of these individuals and was last isolated in July 1958, nearly 4 years after the epidemic.

The history of another family has been related to us by their private physician. He has been attempting to eradicate type 80/81 from this family for well over a year. In this case there had been no recent direct hospital contact. Two siblings had vacationed for a month with an uncle who had been having recurrent boils and carbuncles for a year, his problem

having started shortly after he was discharged from the hospital following elective surgery. The 80/81 strain was isolated from his lesions, and the hospital in which he had surgery was found to have a staphylococcal disease problem.

Although not representative, these cases illustrate the extent to which infection may become a serious problem for the family and point up the very great difficulties of eradicating the infection from the family group. Treating the family as a unit with an appropriate antibotic appears to be effective in some instances, but by and large results in failure. According to a personal communication in 1958, Colbeck has had some encouraging results following thorough disinfection of the household. It is probably fair to state, however, that at the moment there is no really satisfactory approach to the eradication of the epidemic strains from the family and that, in a good percentage of the cases, staphylococcal disease may be expected to recur over long periods despite repeated attempts at eradication.

These findings certainly underline the importance of controlling nursery outbreaks. In addition, they have certain practical implications. During nursery epidemics it is not unusual for the majority of infants to develop their disease following discharge from the hospital. The number of cases of frank disease occurring in the nursery are frequently below the threshold of recognition. Unless the infants developing postdischarge disease are properly diagnosed and reported back to the hospital, an epidemic situation may continue undetected for long periods. This implies that the prompt detection and control of hospital epidemics requires the cooperation of individuals and agencies outside the hospital. The adequate provision of laboratory services, a reporting system, and survey techniques for the detection of lesions unattended or unreported by physicians are essential to the control of the hospital situation. With respect to nursery outbreaks, then, the universe of concern clearly extends beyond the hospital walls and includes the entire community of which the hospital is a part.

Whether these findings apply to the postsurgical infections of the hospital-infected adult medical patient is less clear. It has been shown repeatedly that hospital patients acquire antibiotic resistant strains of staphylococci during their hospital stay and are carrying them on their skin or mucous membranes at the time of discharge (*8*, *9*). Some degree of transmission to family members of nonepidemic "hospital strains" resistant to antibiotics has been demonstrated (*8*), but the seriousness of a potential increase in the endemic level of community staphylococcal disease needs further exploration. Infections with antibiotic resistant strains certainly present more difficult therapeutic problems and appear to be resulting in a higher case fatality rate than infections with sensitive strains (*10*, *11*). As the hospital is a primary community source of antibiotic resistant staphylococci, hospital-acquired staphylococcal infections are a threat to the community. While the role of official public health agencies and an organized community in the detection and control of these infections is less clear than in the case of nursery disease, the need for community interest and awareness and the responsibility of community agencies for the provision of service to assist the hospital is surely as great.

In summary, it would appear fair to state that hospital-acquired staphylococcal disease is a hazard to the community because it threatens the efficiency of hospital operation and because, at least in the case of type-specific nursery disease, acts as a focus for a serious increase in the level of community-acquired staphylococcal disease. In addition, it is likely that hospital epidemics may go undetected unless the hospital-acquired disease occurring after discharge is promptly found and brought to the attention of the hospital. Organized community effort to provide epidemiological and laboratory services, the prompt reporting and analysis of incidence data, and surveys for hospital-associated morbidity undetected by other means are essential to the control of hospital epidemics.

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Nursing Opportunities in the Public Health Service

Staff nurses, head nurses, and supervisors are employed in 16 major Public Health Service hospitals in the United States and in 55 Public Health Service Indian and Alaska native hospitals. Clinical nurses are also employed in the Clinical Center, the Service's 500-bed research hospital at the National Institutes of Health. Twelve of the 16 hospitals provide general medical and surgical services; 1 is exclusively for tuberculosis cases; 2 are for treatment of narcotic addiction and other neuropsychiatric disorders; and 1 is the only hospital in continental United States devoted exclusively to care of leprosy patients. There are opportunities for teaching and training at all levels.

Total bed capacity of the 16 major hospitals in the United States ranges from 135 to 1,250 beds; the total capacity in the Indian and Alaska native hospitals is about 3,800, with bed capacity per hospital ranging up to 400.

In the field of public health nursing, opportunities are available in epidemiological investigations and studies, in public health activities in the Indian health program, in general and special public health programs (such as heart disease control, tuberculosis control, venereal disease control, and quarantine activities), and in technical assistance programs overseas.

Entrance salaries for Public Health Service professional nurses were recently raised by 10 percent. They now range from $4,040 a year for GS–5 beginners (formerly $3,670) to $9,890 for GS–13 program heads (formerly $8,990). For nurses with a year of experience, the new rate is $4,490 a year (formerly $4,080).

Further information on nursing opportunities may be obtained by writing to the Surgeon General, U. S. Public Health Service (P), Washington 25, D. C.

Coincident with progress in the eradication of brucellosis in Minnesota's cattle, the number of human cases have significantly decreased.

Effect of Eradicating Brucellosis in Cattle on Incidence of Human Cases

JOE R. HELD, D.V.M., HENRY BAUER, Ph.D., and RALPH L. WEST, D.V.M.

BRUCELLOSIS was first reported in humans in Minnesota in 1927, and there was a general trend toward an increasing number of cases until 1946. Since 1946, however, the trend has been downward. Whereas the case rate per 100,000 population was 0.24 in 1927, it was 1.94 in 1956. The maximum case rate of 13.84 occurred in 1946 (table 1). The purpose of this study is to show the effect of the area certification program on this rise and fall in the reported number of human cases of brucellosis.

One can assume that, as with any disease, an awareness of the disease's presence in the State was needed before the majority of cases could be diagnosed properly as brucellosis. In 1927, serologic and bacteriological services were introduced into the laboratories of the Minnesota Department of Health to aid in the diagnosis of brucellosis. These services were accepted by practicing physicians and have been used increasingly since that time.

It should be noted here that the only cases counted by the Minnesota Department of Health are those confirmed by an agglutination test with a titer of at least 1:80, accompanied by clinical symptoms suggestive of brucellosis, or confirmed by isolation of the organism from blood cultures.

Other factors undoubtedly affecting the number of human cases of brucellosis in Minnesota are the number of cattle in the State and the extent of the area certification program pertaining to brucellosis in cattle.

Statewide pasteurization of milk may also have played a role in decreasing the incidence of infection in humans. A law requiring pasteurization was enacted in 1949, and a regulation prescribing minimum standards for grade A milk became effective under that law on March 31, 1952. No attempt will be made in this paper to evaluate the effect of pasteurization in itself, since for our purposes the presence of *Brucella* organisms in milk merely signifies an infected animal.

In 1939 the Minnesota Legislature enacted a law authorizing the State Livestock Sanitary Board to control and eradicate brucellosis in cattle by means of an area plan. Under this plan, all cattle owners in a specified area are required to participate in a testing program. The law also provides for the slaughter or iso-

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Table 1. Brucellosis in humans, Minnesota, 1927–56

Year	Cases [1]	Deaths [1]	Population [2] (in millions)	Case rates per 100,000
1927	6	0	2. 51	0. 24
1928	12	0	2. 53	. 47
1929	42	0	2. 55	1. 64
1930	62	0	2. 56	2. 42
1931	72	2	2. 59	2. 78
1932	62	3	2. 61	2. 38
1933	72	0	2. 63	2. 74
1934	102	1	2. 66	3. 83
1935	114	3	2. 68	4. 25
1936	77	2	2. 70	2. 85
1937	89	5	2. 72	3. 27
1938	85	0	2. 75	3. 09
1939	92	3	2. 77	3. 32
1940	137	3	2. 79	4. 91
1941	177	1	2. 81	6. 29
1942	260	1	2. 83	9. 18
1943	326	1	2. 85	11. 43
1944	395	0	2. 87	13. 76
1945	352	1	2. 89	12. 17
1946	403	1	2. 91	13. 84
1947	378	0	2. 93	12. 90
1948	295	1	2. 94	10. 03
1949	349	0	2. 96	11. 79
1950	281	0	2. 98	9. 42
1951	188	1	3. 02	6. 22
1952	135	0	3. 07	4. 39
1953	131	1	3. 11	4. 21
1954	149	0	3. 15	4. 73
1955	114	0	3. 19	3. 57
1956	63	0	3. 25	1. 94

[1] From records of the Minnesota Department of Health.

[2] Population figures between censuses were interpolated.

lation of all cattle reacting to tests and regulates the importation of any cattle into the area according to whether the animals, or herds from which they originate, are infected or not. By 1956 all the counties in the State were operating under this plan.

The area plan of control, as it is operated in Minnesota, has been successful. There has been a steady increase in the number of counties that have attained a certified status, except during World War II and the immediate postwar period when progress in eradication nearly came to a standstill.

More important, perhaps, is that the testing for recertification at the intervals required by State law and the Uniform Methods and Rules of the U. S. Department of Agriculture continues to show a decrease in the incidence of brucellosis in cattle. This favorable progress is probably attributable to the Minnesota law and regulations that provide for the blood agglutination test of all cattle as the basis of the eradication program. The milk ring test and calfhood vaccination, while used extensively, are considered only as supplements to the systematic blood testing of all cattle.

Effects of Program

Figures 1–4 compare the number of cattle (taken from the U. S. Department of Agriculture's official estimates of all cattle and calves on farms on January 1 of each year) with the number of human cases of brucellosis, the percentage of counties under the area certification program, and the number of cattle reactors to brucellosis which were slaughtered. From these figures it can be seen that from 1927 to 1948 when numbers of cattle increased or decreased, there was usually a corresponding increase or decrease in the number of human cases of brucellosis. From 1949 to 1956, however, this relationship was no longer evident.

It is apparent from the data in the figures that the area control program was effective in reducing human cases of brucellosis. During 1949–50 the number of counties joining the area test program began to increase sharply. The years 1949–51 were the beginning of a rise to new heights of the cattle population and the number of cattle reactors slaughtered. Concurrent with these upward trends there was a marked downward trend in the number of reported human cases of brucellosis.

Table 2 shows the number of counties certified year by year in Minnesota and the case rates in the certified counties as contrasted with those in the noncertified counties. The life table approach has been used in preparing this table.

The total experience shows that since 1940, when the first counties were certified, the case rate has been 3.12 times greater in noncertified than in certified counties.

Each year since 1942, except 1955 and 1956, the case rates have been significantly higher in noncertified counties. In 1955 and 1956, how-

ever, there was a great shift in the population from a noncertified to a certified status. This fact, coupled with the incubation period of brucellosis and the difficulties that sometimes arise in establishing a diagnosis, probably contributes to creating a lag effect, so that cases that actually occurred under noncertified conditions are being reported after the area has become certified. The difference in case rates in 1956 is not statistically significant, which tends to uphold this hypothesis.

Brucellosis in Humans From Cattle

The question may arise as to whether or not the real problem of brucellosis in humans in Minnesota originates from contact with cattle. In addition to blood samples submitted routinely for *Brucella* culture, the division of medical laboratories of the Minnesota Department of Health attempts to obtain blood specimens for all individuals who show a *Brucella* antibody titer of 1:320 or higher. Of course, by the time arrangements are made to have blood submitted for culture, the patient is not always in that stage of the disease where there is bacteremia.

Figure 1. Number of cattle on farms, Minnesota, 1927–56.

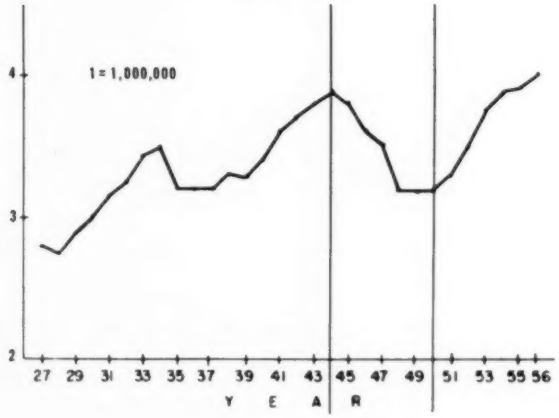

Figure 2. Reported number of human cases of brucellosis, Minnesota, 1927–56.

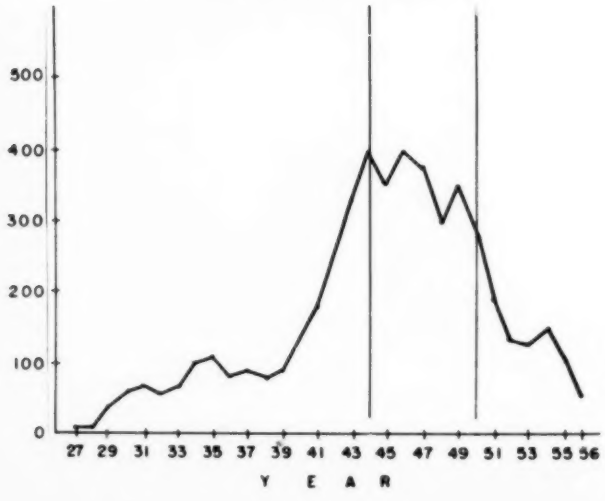

Figure 3. Number of Minnesota cattle reactors to brucellosis slaughtered, 1937–56.

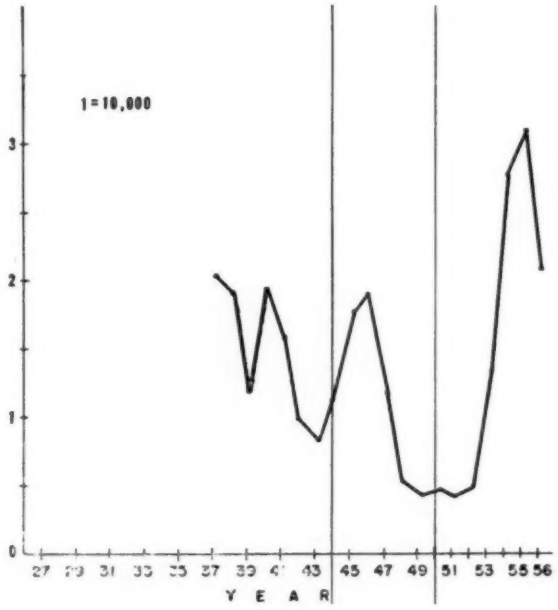

Figure 4. Percentage of counties under the area control program for brucellosis in cattle, Minnesota, 1939–56.

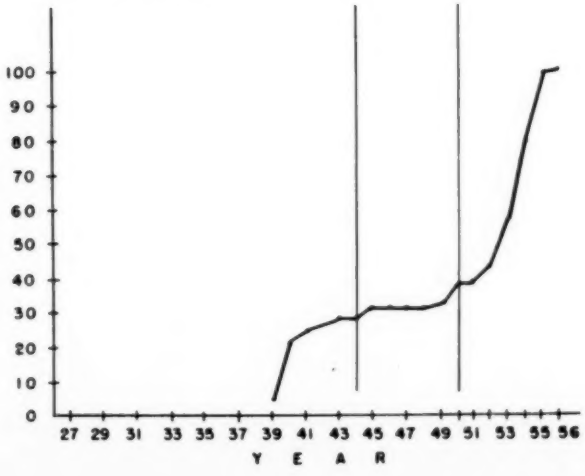

Table 2. Total human case rates of brucellosis in certified and noncertified counties, Minnesota, 1937–56

Year	Number of certified counties by end of year [1]	Number of noncertified counties by end of year [1]	Person-years risk in certified counties (in millions) [2]	Person-years risk in noncertified counties (in millions) [3]	All cases in certified counties [4]	All cases in noncertified counties [4]	Case rates in certified counties [5]	Case rates in noncertified counties [5]	Ratio of certified CR to noncertified CR
1937	0	87	----------	2. 7923	--------	89	----------	3. 19	----------
1938	0	87	----------	2. 7923	--------	85	----------	3. 04	----------
1939	0	87	----------	2. 7923	--------	92	----------	3. 30	----------
1940	7	80	0. 0563	2. 7360	1	136	1. 78	4. 97	1:2. 79
1941	13	74	. 1617	2. 6306	5	172	3. 09	6. 54	1:2. 12
1942	20	67	. 3635	2. 4288	13	247	3. 58	10. 17	1:2. 84
1943	21	66	. 5251	2. 2672	15	311	2. 86	13. 72	1:4. 80
1944	22	65	. 5491	2. 2432	22	373	4. 01	16. 63	1:4. 15
1945	22	65	. 5491	2. 2432	24	328	4. 37	14. 62	1:3. 35
1946	22	65	. 5491	2. 2432	18	385	3. 28	17. 16	1:5. 23
1947	22	65	. 5491	2. 2432	22	356	4. 01	15. 87	1:3. 96
1948	22	65	. 5491	2. 2432	18	277	3. 28	12. 35	1:3. 77
1949	22	65	. 5491	2. 2432	33	316	6. 01	14. 09	1:2. 34
1950	23	64	. 5595	2. 4229	9	272	1. 61	11. 23	1:6. 98
1951	24	63	. 5691	2. 4133	15	173	2. 64	7. 17	1:2. 72
1952	26	61	. 5903	2. 3921	7	128	1. 19	5. 35	1:4. 50
1953	29	58	. 6280	2. 3544	11	120	1. 75	5. 10	1:2. 91
1954	35	52	. 7204	2. 2620	10	139	1. 39	6. 15	1:4. 42
1955	54	33	1. 1775	1. 8049	65	49	5. 52	2. 72	2. 03:1
1956	78	9	1. 8386	1. 1438	45	18	2. 45	1. 57	1. 56:1
Total	--------	--------	10. 4846	38. 3152	333	3, 800	3. 18	9. 92	1:3. 12

[1] From records of the Minnesota Livestock Sanitary Board.
[2] Based on the formula: person-years at risk = population in certified counties previous year plus one-half the added certified population.
[3] Total population minus the person-years at risk in certified counties during the current year.
[4] From records of the Minnesota State Department of Health.
[5] Based on the formula: CR = cases × 100,000 ÷ person-years at risk.

Table 3. Blood cultures positive for Brucella in humans, Minnesota, 1932–56 [1]

Year	*B. abortus*	*B. suis*	*B. melitensis*	*B. melitensis or suis* [2]	Year	*B. abortus*	*B. suis*	*B. melitensis*	*B. melitensis or suis* [2]
1932	13	----------	----------	0	1946	98	6	4	----------
1933	6	----------	----------	0	1947	71	6	7	----------
1934	2	----------	----------	0	1948	62	0	5	----------
1935	9	----------	----------	0	1949	41	4	17	----------
					1950	22	8	4	----------
1936	4	----------	----------	1					
1937	1	----------	----------	0	1951	23	8	1	----------
1938	1	----------	----------	1	1952	17	10	1	----------
1939	1	----------	----------	3	1953	21	6	0	----------
1940	31	----------	----------	7	1954	25	2	0	----------
					1955	20	0	0	----------
1941	34	----------	----------	2					
1942	22	----------	----------	9	1956	6	1	2	----------
1943	33	----------	----------	11					
1944	51	----------	----------	20					
1945	65	8	9	----------					

[1] From the records of the Minnesota Department of Health. Cultures were not made prior to 1932.
[2] Prior to 1945 dye test plates were not used, and further identification of these two species was not made.

The isolations that are made, however, represent a random sampling of all reported cases. Table 3 gives the number and type of *Brucella* organisms isolated from blood cultures for the period 1932 to 1956. From this information it can be seen that the majority of patients were infected with *Brucella abortus*. Since it is known that in animals *B. abortus* is mainly found in cattle, it seems safe to assume that the majority of human cases in Minnesota resulted from contact with cattle.

Summary

Coincident with progress in the eradication of brucellosis in cattle, there has been a significant reduction in the number of human cases.

From 1927 to 1948, when the number of cattle increased or decreased, there was a corresponding increase or decrease in the number of human cases of brucellosis in Minnesota. But from 1950 to 1956 the number of human cases declined markedly in spite of a high increase in the cattle population. This change in trend results from the elimination of some sources of human infection by the acceleration of the program for eradicating the disease in cattle.

Since 1940, when the first counties were certified as brucellosis free, the total experience has shown that the human case rate for brucellosis has been 3.12 times greater in noncertified areas than in certified areas.

Infant Care

The booklet Infant Care first published in 1914, soon after the establishment of the Children's Bureau, is now in its 10th edition. In addition to 40 million copies sold in this country, it has been translated and widely distributed abroad.

The 10 editions reflect the history of child care practices in the United States. In 1914, for example, fathers were advised not to play with an infant son or daughter because it might result in "nervous disturbances of the baby and upset his regular habits." Experts now agree that infants need the attention of their fathers as well as their mothers.

In 1914 Infant Care did not advise even strained fruits until a baby was 7 or 8 months old, and solid foods were not recommended until after a baby was 1 year old. Today's Infant Care baby gets fruit juice at 2 weeks and solid foods within the first few months of his life.

The Children's Bureau is planning the 11th revision of Infant Care. As in the past, the Bureau will have the advice of a technical advisory committee, composed of physicians who represent four major medical societies, and the guidance of parents, psychologists, nurses, nutritionists, anthropologists, social workers, parent educators, and others.

With the northward movement of yellow fever, the Public Health Service is intensifying its program for control of Aedes aegypti, particularly in international traffic zones of the yellow fever receptive area of the United States.

Measures Against Yellow Fever Entry Into the United States

JOHN H. HUGHES, Ph.D., and JOHN E. PORTER, Ph.D.

THE SURGEON GENERAL of the Public Health Service is authorized by the Public Health Service Act to make and enforce regulations for preventing the introduction of diseases of man into the United States and their spread in this country. The Division of Foreign Quarantine has the responsibility for preventing the importation of disease. This responsibility requires enforcement of quarantine regulations applicable to all traffic arriving by air, sea, or land.

Although there are other important diseases affecting man, the Public Health Service foreign quarantine regulations place particular emphasis on smallpox, cholera, plague, louseborne relapsing fever, louseborne typhus, and yellow fever. These diseases are recognized by the World Health Organization and by the health departments of many countries as the six quarantinable diseases. Five of them involve insects in their transmission and therefore are of particular interest to entomologists.

There are a number of entomological problems in quarantine operations, but at this time particular consideration will be given to the detection and control of *Aedes aegypti* Linn. at airports, in dock areas of seaports, and at land-entry points. *A. aegypti* has played an important role in the transmission of yellow fever in many countries around the world, and it is the only widely distributed mosquito in the United States that is known to be a natural transmitter of the yellow fever virus.

However, *Haemagogus equinus*, a species of mosquito found naturally infected with yellow fever in Guatemala (*1*), occurs near Brownsville, Tex., in limited numbers. This forest-type mosquito was collected in the Brownsville area in 1955 by Trapido and Galindo (*2*), who found it in tree holes of thorn scrub; in 1957, by Eads and Strom (*3*), who found it in water in tree holes of Texas ebony, *Pithecolobium flexicaule;* and by Strom (unpublished record). Breland reported *H. equinus* from cavities in the Texas ebony and from a hackberry tree (*4*). This interesting addition to the mosquito fauna of the United States has a range extending southward from the Brownsville area to Colombia, South America, and is the only representative of the genus *Haemagogus* reported in the United States.

Historical Note

Historically, yellow fever in its urban form has occurred on numerous occasions in epidemic

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proportions in the United States. The last epidemic in this country occurred during the period July to December 1905, with 8,399 cases and 908 deaths (*5*).

Twenty-six cases of yellow fever, exclusive of laboratory cases such as those reported by Berry and Kitchen for the period 1929–31 (*6*), have been reported in the United States since the 1905 epidemic. Twenty-three of these were intercepted on ships in international traffic which arrived at Public Health Service quarantine stations. These cases are reported in the annual reports of the Public Health Service as follows:

Fiscal year	*Cases*	*Deaths*
1907	6	1
1908	3	3
1911	1	0
1912	1	0
1913	1	0
1917	2	0
1922	5	0
1923	[1] 3	0
1924	[1] 1	0

[1] Suspected.

In addition, one case of unknown origin occurred in New Iberia, La., in August 1906; another occurred in Honolulu during October 1911 in a quarantine station employee who was detailed as a guard on a vessel on which a case of yellow fever was present; and an immigrant from Mexico was reported to have died of yellow fever in Houston, Tex., October 8, 1924 (*7*).

Northward Movement

One of the current problems facing the Public Health Service and other health agencies and involving entomology and related disciplines is the northward movement of yellow fever in the Americas. This disease was reported in both its urban and sylvan forms in Trinidad, B. W. I., in 1954 (*8, 9*) and in its sylvan form in various countries of Central America following its appearance in the Pacora area of eastern Panama in 1948. Human cases of sylvan yellow fever occurred in Panama during the period 1948 to 1952, in Costa Rica in 1951 and 1952, in Nicaragua in 1952, 1953, and 1954, and in Honduras in 1954 (*10*). According to the Weekly Epidemiological Reports of the Pan American Sanitary Bureau, in Panama the disease was again detected in man in 1956 and 1957, and human cases were reported in Guatemala in 1957. Also, as reported in the Weekly Epidemiological Reports, sylvan yellow fever occurred in the simian population in the forested areas of the countries enumerated, and in 1957 the disease in monkeys was found in British Honduras.

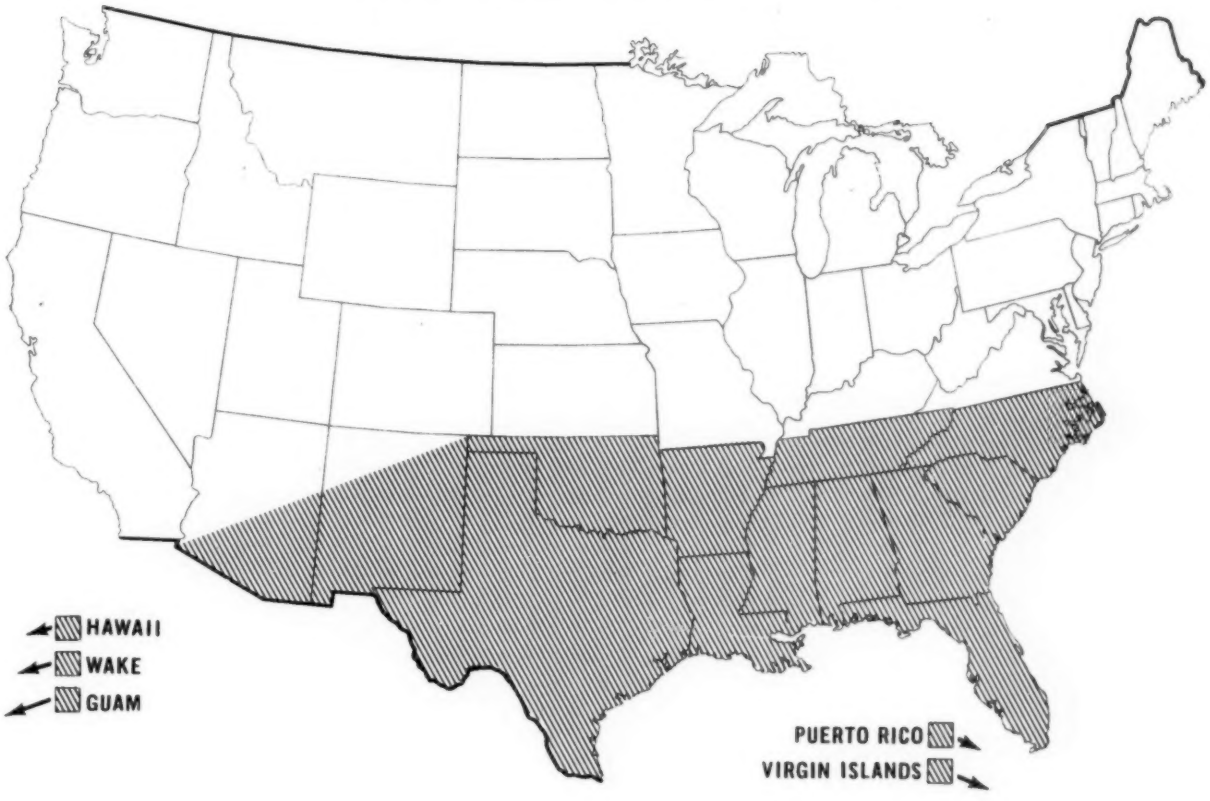
The yellow fever virus was isolated from naturally infected *Haemagogus mesodentatus* K. and K., *Haemagogus equinus* Theob., and *Sabethes chloropterus* Humboldt collected in Guatemala in 1956 (*1*), and from *Haemagogus lucifer* (H. D. and K.) collected in Panama in 1957 (*11*), thus adding substantially to the list of known and potential transmitters of the yellow fever virus in nature. Sylvan yellow fever, as reported in the Weekly Epidemiological Reports, has occurred in all countries of Central America except El Salvador. Thus, only Mexico separates the continental United States from the Central American countries where yellow fever is known to occur.

Receptive Areas

Under the terms of the World Health Organization International Sanitary Regulations now in force (*12*), areas in which the virus of yellow fever does not occur, but in which *A. aegypti* or any other domiciliary or peridomiciliary vector of yellow fever is to be found under conditions that would permit development of the virus in the event of its introduction, are considered receptive to this disease and must be so declared. Thus, the area of the United States, including insular Territories and possessions, where *A. aegypti* occurs constitutes our yellow fever receptive area. Although yellow fever does not occur in this area, it might conceivably be introduced and become established, at least temporarily.

The yellow fever receptive area of the United States, as delineated by the Public Health Service and reported to the World Health Organization in 1953, in accord with article 70 of the International Sanitary Regulations, comprises 13 southern States, Puerto Rico and the Virgin Islands in the Caribbean area, and Hawaii and Wake Island in the Pacific area. Also, Guam has been added to this list, as reported in the Weekly Epidemiological Record of the World Health Organization, January 1958. In the

Yellow fever receptive area in the United States.



yellow fever receptive area (see map) the incidence of *A. aegypti* is considered sufficiently high to support yellow fever transmission, particularly during the warm months of the year. The delineated area will be modified as may be necessary to reflect changes in the distribution pattern of the mosquito.

Preventing Entry Into the U. S.

The United States has a human population which presumably is not immune to yellow fever; it has a widespread distribution of a mosquito vector of the disease; and it has a history of outbreaks of the disease. Also, the disease is present in areas comparatively close to our possessions in the Caribbean area and to our southern ports and land-entry points. Furthermore, modern rapid transportation makes it possible for persons in the incubation stage of the disease and infected mosquitoes, monkeys, or other animals to bring in the yellow fever virus from countries where it now occurs.

Although the last outbreak of yellow fever in this country occurred more than half a century ago, and no cases of the disease have been reported on ships or other conveyances arriving at United States ports for more than 30 years, we cannot be assured of its continued absence from this country.

Activities directed toward preventing the introduction of yellow fever into the United States are being carried on at various ports of entry as a part of a broad quarantine program. These include:

- Requirement of a valid yellow fever vaccination certificate of any traveler from a yellow fever area who arrives in or is destined for the yellow fever receptive area within the incubation period of the disease.
- Medical examination of persons arriving from yellow fever areas and, if necessary, their surveillance or isolation.
- Inspection of monkeys and certain other primates coming from yellow fever areas, and requirement of immunization against the disease or retention in a mosquito-proof crate or

other structure for a minimum of 9 days immediately before arrival in the yellow fever receptive area.

• Disinsectization of aircraft and ships and the entomological surveillance of airports and dock areas (*13*).

Aedes aegypti Control Programs

For many years the control of *A. aegypti* and other mosquitoes has been an important part of the disease control program of the Public Health Service. During the latter years of yellow fever occurrence in this country, various sanitary measures, including mosquito control, often were employed on ships arriving at United States ports (*14*). With the advent of international aerial traffic, disinsectization measures were incorporated into the quarantine clearance requirements, particularly for aircraft arriving from foreign countries where yellow fever was prevalent. Supplemental to the disinsectization measures applied to aircraft and to some ships, an entomological surveillance and control program was put into operation and maintained at airports (*15*) and in dock areas having a southerly location and where international traffic is most active.

Prior to and during World War II the Public Health Service made other efforts to reduce the population of this mosquito in some of the major airport and seaport areas in the south. In the late 1930's the Division of Foreign Quarantine cooperated with certain counties in southern Florida in conducting mosquito abatement programs to reduce the *A. aegypti* population, particularly in areas of heavy international traffic. With the outbreak of hostilities the Service expanded these activities and, in collaboration with State health agencies, conducted a more extensive campaign in ports of entry in the south. These programs were directed toward reduction in the number of *A. aegypti*, as a means of protection against the introduction and establishment of yellow fever (*16*), and toward the training of available personnel, who could be called upon to assist in any part of the country, should yellow fever (or dengue) be introduced. Although the Public Health Service *A. aegypti* control program was discontinued after the close of World War II, other, more limited programs have been conducted by local health departments.

In July 1957 the Public Health Service appropriation provided limited funds for the Division of Foreign Quarantine and the Communicable Disease Center to collaborate in investigations of *A. aegypti* control in the United States, including an evaluation of the threat of yellow fever in this country. These investigations should enable the United States to comply more fully with the terms of article 20 of the World Health Organization International Sanitary Regulations (*12*), which state, "Every port and the area within the perimeter of every airport shall be kept free from *Aedes aegypti* in its larval and adult stages."

The Division of Foreign Quarantine's portion of this broader and more comprehensive program consists of the establishment of entomological units at Miami, Fla., Brownsville, Tex., and New Orleans, La. These units will survey their respective base stations, and other areas as directed, to determine the presence and abundance of the yellow fever mosquito on various types of conveyances and at airports, dock areas of seaports, and border-crossing points in the yellow fever receptive area. Control measures and cleanup campaigns will be carried on in conjunction with the surveys. It is expected that some investigations and observations will be made with respect to possible insecticide resistance, survey and control techniques, biology and behavior of *A. aegypti*, and other aspects of prevention of importation of yellow fever.

The Communicable Disease Center will make surveys and otherwise obtain information to determine the distribution and abundance of the urban vector of yellow fever throughout the yellow fever receptive area and will carry on a project in a coastal city to ascertain costs and methods involved in eradication of *A. aegypti* in a specific urban area and the applicability of similar programs in other urban communities in the receptive area. As resources permit, CDC will make other field and laboratory investigations apropos of an *A. aegypti* and yellow fever control program.

The most active phase of the *A. aegypti* control program carried out by Division of Foreign Quarantine workers has been confined largely to the more important international traffic areas

of Florida and Texas. During the period July 1957–June 1958, the Miami entomological unit made *A. aegypti* surveys in airports and dock areas in more than 25 localities in Florida, including Fort Pierce, Jacksonville, Miami, Pensacola, St. Petersburg, Tampa, and West Palm Beach. *A. aegypti* breeding was observed in 6 of the Florida airports inspected, with indexes as high as 4.0 percent. Breeding was also detected in 10 of the Florida docks inspected, with indexes as high as 9.0 percent. Outside Florida, similar surveys made during the spring of 1958 in a number of airports and dock areas along the Atlantic coast as far north as North Carolina revealed sparse breeding in one dock area in late June.

Most of the *A. aegypti* breeding was localized in overhaul and salvage areas of the airports inspected and was not observed in the active traffic areas. Comparable conditions existed in the dock areas. Control measures included application of DDT spray and, when feasible, removal or destruction of containers or making them unsuitable for supporting *A. aegypti* breeding. Port authorities and health officials in the area surveyed were apprised of the control problem and of results obtained in the surveys.

One finding of particular interest made by the Miami entomological unit was extensive *A. aegypti* breeding at the Key West, Fla., main city dock in water contained in old tires. This observation, made November 13, 1957, is particularly significant in view of the fact that this mosquito had not been reported on Key West since November 1948 (J. A. Mulrennan in personal communication, 1958). Although it is not known when or actually how *A. aegypti* returned to that island, continuous entomological surveillance is obviously necessary if costly and potentially dangerous health problems of this type are to be prevented.

During the early months of the program it has been possible to give only limited attention to the airport and dock areas in New Orleans with reference to *A. aegypti* breeding. However, no evidence of this mosquito has been found in the surveys. The program in this locality is being accelerated.

Negative results also were obtained in searches for *A. aegypti* at airports and in dock areas of several port cities in Texas, including Brownsville, Houston, Galveston, and Corpus Christi, during the year ending June 30, 1958. Numerous potential *A. aegypti* breeding places were inspected and treated.

Outside the continental United States, emphasis is being placed on extension of the control program to international traffic areas in Hawaii, where the mosquito is present, although apparently in diminishing numbers, and in Puerto Rico and the Virgin Islands.

The current intensification of *A. aegypti* control activities by the Public Health Service should provide exact knowledge on which to base plans, not only for eradication of *A. aegypti* from the United States, but for a continuing quarantine program to prevent reintroduction of either the virus or the vector.

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New PASB Appointments

Dr. Abraham Horwitz of Chile has been elected director of the Pan American Sanitary Bureau, regional office of the World Health Organization, succeeding Dr. Fred L. Soper, who will end his third term January 31, 1958.

The vote was taken October 1, 1958, in San Juan, Puerto Rico, at the Pan American Sanitary Conference, which is also the regional meeting for WHO members in this hemisphere. Dr. Horwitz's name will be presented to the WHO Executive Board in January 1959 for appointment.

The director-elect, who is on leave from his post as director of the School of Public Health of the University of Chile, is currently serving as assistant director of that country's National Health Service. He has been PASB consultant in training and education to various countries in the Americas. From 1952 to 1953 he was chief of the professional education branch at the regional office headquarters.

Dr. Horwitz received his doctorate of medicine from the University of Chile in 1936 and a master's degree in public health from Johns Hopkins University.

Harold R. Shipman has been appointed chief of the Pan American Sanitary Bureau's Branch of Environmental Sanitation.

Since he joined the World Health Organization's staff in 1952, Mr. Shipman has served in Turkey, Egypt, Austria, and the Americas. Previously, he was a sanitary engineer with the Minnesota Department of Health, the Farm Security Administration of the U. S. Department of Agriculture, and the American Red Cross in Korea.

Mr. Shipman holds a bachelor of science degree in chemical engineering and bacteriology and a master of science degree in sanitary engineering from the University of Minnesota. He is the author of various publications on sanitary engineering and is considered an authority on water supply and sewage disposal.

Free Medical Care in Cities

SELMA MUSHKIN, Ph.D., and BEATRICE CROWTHER, B.A.

Approximately 7 percent of urban residents reported receipt of free medical services in 1950. Almost 4 of each 10 persons reporting receipt of some free services indicated they received physician services free; 1 of 5 reported hospital services; and another 1 of 5 reported laboratory tests, immunizations, or X-rays. More than 4 of each 10 persons reporting free care indicated they received free care in public hospitals or through public assistance or private voluntary agencies.

A larger proportion of persons spending $500 or more out-of-pocket for medical services reported free care than of those spending smaller amounts for medical services. Almost 9 percent of persons 19–44 years of age reported free care as compared with 4 percent of the population under 6 years of age. About 1 of 8 urban household members hospitalized during 1950 reported some free hospital services.

ONE important financial aspect of medical services is the volume of free care provided for families by a multiplicity of public and private agencies. There is a paucity of data on the volume and relative importance of public and private aid in meeting medical care needs. In 1950, public expenditures for health and medical services aggregated about $2.4 billion; and voluntary health and welfare agencies spent $370 million (*1*).

Household surveys can provide only a partial picture of free care, for the types of medical services that are financed by private and public aid often include long-term institutional care, such as that given in mental hospitals, which removes the recipient from the household. Yet it is of interest to determine even in an incomplete way the numbers of persons receiving free care, the nature of this care, and the types of agencies providing it.

In view of the interest in this aspect of financing medical services, we processed data on free medical care reported in a subsample of family interviews. The information was gathered by the Bureau of Labor Statistics from 12,500 urban families in its survey of consumer expenditures in 1950. In all, 2,414 families and 7,639 persons were included in the subsample. The methods of sampling and weighting the subsample to estimate an urban aggregate have been presented in other articles (*2*, *3*). The subsample included 50 percent of the families reporting no out-of-pocket medical care expenses, 10 percent of those reporting some medical expenses but in amounts less than $200, 20 percent of those reporting $200 to $400, 50 percent of those reporting $400 to $1,000, and all families reporting medical expenditures of $1,000 or more (see table 1).

Totals for each of the medical care expense classes were weighted to adjust for the subsample size within each of the nine geographic regions used by the Bureau of Labor Statistics for its sample weights. Each of the nine regions in turn was then weighted in accordance with the relative population of these regions as estimated by the Bureau of Labor Statistics.

Definition of Free Care

The Bureau of Labor Statistics interview included the following questions as part of its section on medical and personal care: Did any family member receive medical care free in 1950? If yes, about how much was it worth?

In the interview, information was asked

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about each member of the family. The interviewers were instructed, with regard to these questions, that free medical care "is available in many cities in public and private clinics and health centers. Free chest X-rays are given by the Public Health Service. In addition, many employers have a doctor on their staff who provides medical care to employees at no charge. It may be difficult for a respondent to estimate the value of such service but ask him to give you his best guess, and to describe in detail what he received. Write your description of the services received in a footnote. Do not include medical care received because a family member is covered by a prepayment plan" (*4*).

Information on types of free care and their sources is taken from the interviewers' notes as recorded on the interviews. The classifications set forth in tables 2 and 3 are means of grouping the entries and are not part of the original questions.

As the instructions to the enumerators suggest, benefits paid by health insurance plans, including insurance financed in whole or in part by employer contributions, are excluded from free care. However, other types of insurance benefits and medical services recorded as free care by the interviewers were included: (*a*) automobile and other casualty insurance received as a result of an accident, (*b*) workmen's compensation medical services and inplant medical services, and (*c*) medical services in union health facilities and in special railroad hospitals. Other types of free care included care provided in public hospitals or financed under public programs such as public assistance programs, care financed by private welfare, health, and religious agencies and hospitals, and care provided without charge by members of a health profession as a matter of professional courtesy or as charity. The entries on free care appear to exclude medical services received at less than full rates, for example, reduced hospital charges.

There seemed to be some instances in which respondents interpreted free care as care paid for by a relative or friend. We excluded these entries from free care and from the tabulations presented here. Because the value of services was only roughly guessed no attempt was made to tabulate responses on that score. However, the Bureau of Labor Statistics has tabulated these value items as part of the value of free items received for all goods and services. The amount of free medical care, according to an unpublished report of BLS, averaged $19 for all urban families, including families who reported no free care, and $123 for the 15.4 percent of families reporting some free medical care.

Limitations of Data

The Bureau of Labor Statistics study was designed to provide benchmark data on cost of living of urban families. Items of information on the interview that were not related specifically to the consumer price index were not defined as carefully nor edited as thoroughly as other items.

The supplementary nature of the question on free care suggests that interviewers did not seek or obtain detailed and uniform answers. Different respondents may have interpreted the question differently. There are patent differences in the completeness of information obtained by interviewers.

Our findings necessarily reflect the definition of free care used by the Bureau of Labor Statistics, the errors in reporting information, in sampling, and in estimating the aggregates, and the under-reporting of types of free services such as chest X-rays and school health services. In interpreting these findings, furthermore, the small sample size (table 1) must be borne in mind.

Type and Source of Free Care

Urban families reported receipt of a wide range of services free of charge (table 2). These included physician services, hospital care, nursing care, dental services, laboratory tests, immunizations, X-rays, and drugs.

Free hospital services were obtained by 2 in each 10 of those reporting free services, a proportion representing about 1.5 percent of the urban population and almost 12 percent of those reporting hospitalization during the year. This proportion includes persons who reported care without charge (*a*) in State and local public hospitals and in Federal hospitals, including

Veterans Administration hospitals and Public Health Service hospitals, (*b*) through research programs, (*c*) under workmen's compensation, (*d*) under arrangements paid by casualty insurance, such as automobile liability insurance, and (*e*) under public assistance programs.

The proportion of free hospital care indicated by the 1950 consumer expenditures survey is similar to findings of the Health Information Foundation. In its 1952–53 household survey, the foundation found that 1 or 2 percent of all families received only free hospital services (*5*).

The most frequent type of service received without charge was physician care. Of those reporting free service, 4 out of each 10 reported physician services outside of hospitals. Included among these services are those provided by physicians for members of their families, other relatives, employees, professional colleagues, and patients unable to pay, services in outpatient departments of hospitals, industrial inplant medical services, and services provided for workmen's compensation cases. The persons reporting such services represented about 3 percent of the urban population, or about 3 million people.

Services received from physicians on hospital staffs were in many cases included within free "hospital care." There were many instances of hospitalization in which the information reported in the interview did not show out-of-pocket expenses for physician services, insurance benefits received, or free physician care. Many of those reporting care in veterans hospitals and military hospitals, for example, did not report free physician services.

Table 1. Number of persons reporting free care in Public Health Service subsample of Bureau of Labor Statistics interview schedules, 1950

Family out-of-pocket medical care expenditures	Sampling ratio (percent)	Number of persons	Number of persons reporting free care
Total		7,639	572
None	50	633	110
$1–$199	10	2,236	169
$200–$399	20	1,930	104
$400–$999	50	2,287	165
$1,000 and over	100	553	24

Table 2. Percentage distribution of urban residents reporting free medical care, by type of care, 1950

Type of free care	Residents reporting free care	
	Major type	Multiple types
Total	100.0	
Hospital	19.4	19.4
Physician	38.9	59.2
Nurse	1.4	1.4
Dental	6.4	9.0
Laboratory tests, immunizations, and X-rays	18.2	19.0
Clinic	1.2	1.3
Drugs	1.3	5.5
Other	2.6	2.7
No report	10.6	10.6

In other instances, the families reported free physician services along with hospital care. The information was tabulated attributing physician services uniformly to those urban residents reporting free hospitalization, if the information did not otherwise indicate the purchase of physician services. If the multiple entries are counted in this way, almost 6 of each 10 persons reporting free services received free physician care, including, in this instance, free care provided by physicians on staffs of hospitals.

Moreover, for those persons reporting multiple types of free services, a single, major type was selected according to the relative importance of the service. Entries reporting free "hospital care," for example, were counted only as a free hospital service even though other types of care were also noted. Similarly, if the respondent reported free physician care outside of a hospital and also free X-ray, drugs, or other services the care was classified as free physician care. The order of the classification of entries corresponds to the arrangement in table 2.

Table 3 shows a distribution of the sources of free care. Each type of source, when multiple aid was reported, and the major source, as listed, are included.

A large proportion of the respondents, some 28 percent of those reporting free care, did not report the source of free care received. Of

those reporting free care, approximately 13 percent received services as professional courtesy or as charity; another 13 percent received care through public assistance agencies; and for 14 percent services were paid for by employers. Included in the last are inplant medical services, services in connection with workmen's compensation cases, and employer arrangements other than health insurance. As indicated earlier, reporting instructions explicitly excluded services received under health insurance plans toward which the employer contributed all or part of the premium.

Free hospital care was financed by public assistance or by Federal agencies for more than half of those reporting free hospitalization.

Age and Income Differentials

The proportion of persons reporting free care varied by age group (table 4). Free care was reported for only 4 percent of the children under 6 years living in urban households. In contrast, 8.8 percent of those 19–44 years of age reported receiving free care. The percentage of persons 65 to 74 years of age reporting free care was less than the average for all age groups; however, the proportion of those 75 years of age and over was about the same as the average for all age groups.

In view of the volume of care provided for children through schools, clinics, and public health departments, it would appear that free care for children, especially those under 6 years of age, is under-reported.

Table 3. Percentage distribution of urban residents reporting free medical care and free hospital care, by source of care, 1950

Source of free care	Residents reporting free care		Residents reporting free hospital care
	Major source	Multiple sources	
Total	100.0		100.0
Public (State and local) and nonprofit hospitals	6.6	6.6	19.4
Federal agencies	13.6	13.6	26.0
Public assistance	12.6	12.6	30.6
Other organizations	11.1	11.6	1.5
Employers	13.7	13.9	7.7
Health professions	12.6	12.9	5.7
Casualty insurance	1.3	1.3	0
No report	28.5	28.5	9.1

Table 4. Percentage of urban residents in each age group reporting free medical care, 1950

Age group (years)	Percent
All age groups	7.2
Under 6	4.0
6–18	7.4
19–44	8.8
45–64	6.4
65–74	6.1
75 and over	7.5

Tests of income and means applied in the administration of many public programs as well as programs of voluntary welfare and health agencies suggest that persons receiving services provided without charge are primarily in low-income families. Our findings indicate no great concentration of free services in low-income families. Those with relatively high family incomes also received free medical care. Approximately 18 percent of the persons reporting free care were in families with incomes of less than $2,000 per year; about 12 percent of all urban residents in 1950 were in families with incomes below $2,000. At the other end of the income scale, about 5 percent of those receiving free care were in families with incomes of $7,500 or more, whereas 7.6 percent of all urban residents in 1950 were in families with that income (table 5).

A larger percentage of urban residents in families with incomes under $2,000 reported free medical care than those with higher incomes. The percentage of persons reporting free medical care decreases until the income level reaches $4,000 to $4,999 and then tends to increase except for the highest income level. This pattern of receipt of free medical services by income classes may reflect differences in types of free medical services available in the community. While free care contingent on need is available through public programs such as public assistance programs and State and local public hospitals and through veterans' benefits for non-service-connected disabilities, there are other types of medical care programs under which eligibility is connected

with employment. For example, medical care under workmen's compensation, under union and employer plans, and under Government programs (such as the program for merchant seamen and for members of the armed services) is available only to those attached to a work force. Income levels of those receiving such care are related to the earnings in these employments.

The nurse receiving care in the hospital and the relative of a physician or dentist receiving care through his office illustrate another category of care which is not related to low family income.

Medical Expense Differentials

Are free services received primarily by individuals who have no expenses or small out-of-pocket expenses for medical services? Of the urban population as a whole, 17.4 percent reported no out-of-pocket expenses for medical care during 1950, whereas 1.3 percent reported no out-of-pocket spending along with free care. About 48 percent of the urban population reported medical expenditures of $1 to $49; 3.6 percent reported medical expenses of $1 to $49 with free care (table 6). Or stated somewhat differently, there is a curvilinear relationship between receipt of free medical care and size of out-of-pocket medical expenses.

Table 5. Distribution of urban residents and of urban residents reporting free care, by family income after taxes, 1950

Family income group	Percent of all residents [1]	Percent of residents reporting free care	Percent in each income group reporting free care
All income groups	100. 0	100. 0	7. 2
Under $1,000	3. 1	5. 4	12. 9
$1,000–$1,999	8. 6	12. 5	11. 3
$2,000–$2,999	16. 8	16. 2	7. 9
$3,000–$3,999	25. 5	23. 2	6. 5
$4,000–$4,999	19. 1	15. 8	5. 6
$5,000–$5,999	11. 4	12. 4	7. 7
$6,000–$7,499	7. 9	9. 6	6. 9
$7,500 and over	7. 6	4. 9	4. 4

[1] Derived from Study of Consumer Expenditures, Income and Savings; Vol. 18, Summary of Family Incomes, Expenditures, and Savings, All Urban Areas Combined. Philadelphia, Wharton School of Finance and Commerce, University of Pennsylvania, 1957, p. 2.

Table 6. Out-of-pocket medical spending by urban residents and by urban residents reporting free medical care, 1950

Out-of-pocket medical care expenditures	Percent of all residents	Percent of all residents reporting free care	Percent in each expense group reporting free care
Total	100. 0	7. 2	7. 2
None	17. 4	1. 3	7. 6
$1–$49	47. 9	3. 6	7. 4
$50–$99	17. 5	1. 2	6. 9
$100–$199	10. 2	. 7	6. 5
$200–$299	3. 7	. 2	4. 8
$300–$499	2. 1	. 1	5. 6
$500 and over	1. 2	. 1	9. 0

Of urban residents reporting no out-of-pocket expenses, 7.6 percent indicated they received free care; 7.4 percent of those reporting expenses from $1 to $49 reported free care. The percentage of persons reporting free care is lower than average for each of the medical expense classes from $50 to $500 of out-of-pocket expenses. Of those spending $500 and over for medical care, however, 9 percent reported some free care. This finding suggests the need to explore such questions as how private spending for medical care is supplemented by free services, through what agencies and arrangements individuals with expensive illnesses gain access to free services, and whether there are barriers to such access which necessitate large out-of-pocket family spending before free care can be received.

In general, our purpose here has been to stimulate interest in the distribution of free medical care among groups differing in age, income, and medical expense, and to encourage further study.

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Specialized Training Courses in Environmental Health

The following courses are scheduled for January and February 1959 by the Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio:

January 12–23. Basic Radiological Health. Fundamental technical knowledge needed for radiological health work, with stress on basic nuclear physics and chemistry. Prerequisite for several other courses.

January 12–16. Chemical Microscopy for Analysis of Air Pollutants. Emphasizes the applicability of techniques of chemical microscopy, conventional and polarized, to qualitative and quantitative identification of atmospheric particulates.

January 26–30. Radioactive Pollutants in Air. Intensive training for professional persons concerned with radioactive contamination of the air. Laboratory practice, using commercially available sampling and monitoring instruments, comprises about half of the course.

January 26–30. Sanitary Bacteriology of Water. Extensive coverage of bacteriological examination of water, including the most probable numbers methods and the membrane filter method.

February 2–6. Microbiological and Chemical Examination of Milk and Dairy Products. Theory, laboratory techniques, and interpretation of tests used in evaluating the sanitary quality of milk and dairy products.

February 9–13. Laboratory Methods for Prevention and Control of Foodborne Disease. Methods, standards, and operating procedures for a food sanitation program. Demonstrations and laboratory exercises include microbiological and chemical methods for food quality control, and procedures for enumeration, isolation, and identification of food poisoning bacteria.

February 9–20. Community Air Pollution. Broad, technical coverage of air pollution including the roles of the community, State, Federal Government, and industry, and ordinances and legislation.

February 16–20. Radioactive Pollutants in Water. Intensive training for water supply and pollution control officials concerned with the radioactive contamination of water. Prior completion of the basic radiological health course is desirable.

Address applications to the Chief, Training Program, Robert A. Taft Sanitary Engineering Center, Public Health Service, 4676 Columbia Parkway, Cincinnati 26, Ohio, or the medical director in a regional office.

Gerontology

DISCUSSION GROUP

The following are authors' abstracts of presentations to the gerontology discussion group at the National Institutes of Health, Public Health Service, during the first 6 months of 1958.

The planning of this series originated in the gerontology discussion group at the National Institutes of Health. In 1954 a group of about 20 staff members from various fields at the Institutes decided to meet once a month for informal discussion of some selected aspect of gerontology. The meetings have continued to this date with a de-emphasis on formality. The first chairman was Dr. Paul Stevenson of the National Institute of Mental Health, who served, until his retirement at the beginning of 1955, in arranging for speakers in response to suggestions of the group and of scheduling the meetings at appropriate times. In 1957, the discussion group was sponsored by the newly formed Center for Aging Research, under the direction of Dr. G. Halsey Hunt, to encourage the free exchange of information on aging.

Apart from the specific content of the presentations, other facts have emerged about gerontology in this 4-year period. Interests are clustered about certain foci: the molecular level; the general biology of the whole organism; the disease processes; the psychological aspects of aging; and the sociological or societal aspects. These seemed to be the respective interests of the gerontologists themselves at the lectures. It also became apparent in the discussions that it is impossible to compress gerontology into the confines of a single discipline, profession, or dogma.

—JAMES E. BIRREN, PH.D., CHAIRMAN, *chief of Section on Aging, National Institute of Mental Health, Public Health Service.*

Age Changes in Cells

When an animal grows old, cells in various parts of the body deteriorate so that they are no longer able to fulfill their various functions as efficiently as they did when the animal was younger. Why is this true? We should like very much to find out, for if we knew perhaps we could find some way of delaying the aging process.

For many years, cytologists have tried to discover in what ways an aging cell differs from a young cell. The results of their painstaking studies have not been impressive, and even though an occasional morphological change has been described, we know nothing about the why and wherefore of such change. Perhaps the main reason is that cytologists, both those using ordinary light microscopes and those using electron microscopes, have compared the appear-

ance of dead old cells with the appearance of dead young cells. And the methods used in killing cells so that they may be sectioned and stained could easily destroy any evidence of age changes in the protoplasm.

Physically, the cell is a colloidal engine, and it is proper to look for changes in the colloids of which this engine is composed. In order to appreciate the types of changes that may occur, we need to know the nature of the protoplasmic colloid. The work of many years has shown that the interior protoplasm in the cell is fluid surrounded by a stiff cortex.

This protoplasmic fluid does not behave like an ordinary protein or an admixture of such protein and lipid; it is strangely sensitive and can suddenly change from a fluid (sol) state to a more or less stiff gel. This reaction is similar to that occurring when the blood of vertebrates clots. The reaction is dependent on the presence of calcium and also on the activation of a clotting, proteolytic enzyme. Work on the nature and reactions of the protoplasmic colloid has been summarized in two books by the author, the Dynamics of Living Protoplasm, published in 1956, and the Viscosity of Protoplasm, which appeared in 1958.

According to E. Gunther's article in *Protoplasma* in 1957, when plant cells age the outer cortical layer becomes less rigid and the interior protoplasm becomes decidedly more viscous. This is exactly what I found in 1956 for aging egg cells of the marine worm *Chaetopterus*, as reported in *Protoplasma*. The loss of rigidity in the cortex of a cell is generally due to a loss of calcium from this region. The cortex normally behaves as a semipermeable membrane and offers resistance to the passage of ions into a cell. As is well known, the permeability of a cell membrane increases as the presence of calcium in it declines; as the cortex loses calcium, the cell becomes more permeable to calcium ions. The result is that calcium enters aging cells more readily than it does young cells. This is presumably why so many aged cells and tissues have been found to have a higher calcium content than young ones.

Because the protoplasm in the cell interior is so sensitive to calcium, entrance of calcium in increased amounts can cause a clotting reaction, as already noted. For this reason old cells may show increased viscosity of their interior protoplasm or may even become vacuolated, for pronounced clotting often causes vacuolization. Moreover, aging cells tend to suck more and more calcium out of the blood; this tends to lower the calcium content of the blood. Such a lowering of calcium concentration in the blood is known to result in a loss of calcium from the bones, hence the diseases of osteoporosis and osteomalacia, so common in old people.

Naturally, we are far more interested in the age changes that occur in higher animals than in those in plants or in the egg cells of invertebrates. Recently an attempt has been made to study the colloidal changes that occur in the course of the aging process in the cells of cats. Such studies are far more difficult to make and various technical difficulties have to be overcome. However, it is possible to study living muscle fibers of kittens and mature cats, and such studies have commenced. Also attempts are being made to study the colloidal properties of liver cells from cats of various ages.

—L. V. HEILBRUNN, PH.D., *professor of general physiology, University of Pennsylvania, Philadelphia, Pa.*

Aging in Insects

Although not a guarantee of expected results, the wise choice of a suitable animal for laboratory research may often prove to be the basis for the slim margin of difference between success and failure of an experiment.

For studies in aging, members of the largest of all animal phyla, the Arthropoda, appear to be ideal because of their small size, low cost of maintenance, relatively small space requirements for large numbers of animals, and high reproductive potential. Most of all this high reproductive potential is linked to a relatively short life history, as few as 29 days on the average for female houseflies (17.4 for males) and 33 days for adult worker honey bees.

These two species of insects have been the subjects of structural, biochemical, and biological studies from the moment of emergence

through old age. In an early study on the adult worker honey bee, the brain (like that of mammals, including humans) showed a slow but steady fall in number of the original cells from the first day of adult life to a total loss of 35 percent of that number by extreme old age. In the honey bee, enzyme studies of the brain (cholinesterase) and of muscle (phosphatases) related to energy buildup and release failed to show any corresponding changes with age. However, the quantitative relationships among these enzyme systems appear to be concerned with development and maintenance of flight ability, which is well developed in advanced old age. In the male housefly, on the other hand, which loses its ability to fly by the 10th day of adulthood, the wings are frayed, and both the acid phosphatase and the magnesium-activated adenosinetriphosphatase show pronounced drops in activity to a minimum by the 10th day.

During the course of this biochemical study, moreover, it became apparent that male houseflies had a considerably shorter average as well as shorter maximum longevity. By a series of studies involving constant humidity, temperature, and conditions of maintenance and rearing, longevities of male and female flies were compared in offspring from hundreds of generations of breeding of a standard laboratory strain of houseflies. Data accumulated for more than 4,000 pairs of flies of both sexes confirm the presence of an aging factor in the male which results in a longevity that is almost 70 percent higher for the female than the male. Experiments with reduced and enriched diet for the aging adult show that the average longevity of the male is not altered by such dietary variations; the female longevity, on the other hand, can be increased by inclusion of powdered whole milk in a sugar and water diet fed to the aging adult.

In a current study, the possible presence of a "Lansing" factor in the aging of houseflies is being investigated. Eggs, usually collected at a very young parental age, were collected at later and later parental ages; offspring from these collections were isolated and allowed to age under controlled conditions of temperature, humidity, and complete diet. First results clearly indicate that longevity of the male offspring is the same, regardless of the parental age at which the egg has been laid. In the case of the female offspring, after the sixth day of adult life, the older the parents at oviposition, the shorter the average longevity of the offspring. The 30-day mortality of female offspring hatched from eggs collected from parents 27 days old, for example, was 90 percent, exactly equal to that of males from eggs laid at all ages. A mortality of 50 percent was found for female offspring of young parents, on the other hand.

Thus, for the housefly, it appears that there is a relatively immutable aging factor in the male as opposed to an aging or longevity factor in the female which is labile to the extent that a limited diet as well as advanced parental age at the time of oviposition markedly reduces the average and maximum longevities of such females.

Studies are being continued on the relative roles of the male and female parents in the curtailment of the longevity of female offspring hatched from eggs collected at an advanced parental age.

—MORRIS ROCKSTEIN, PH.D., *associate professor of physiology, New York University College of Medicine, New York City.*

Aging and Longevity in Rats Under Favorable Conditions

In 1945, a special rat colony for research on aging and longevity was set up in an old building at the Columbia-Presbyterian Medical Center. We attempted to produce conditions as ideal as possible in the belief that, for satisfactory results, the colony had to be maintained under uniform conditions for a long period, with freedom from noise and other disturbances and with the elimination of infectious diseases.

To this end, we installed an air conditioning system with temperature and humidity control. We adopted a uniform diet, which has been used for the last 13 years. All outside light was closed off. Indirect fluorescent lights were installed on a time switch to give 12 hours of light

and 12 hours of darkness each 24 hours, and special cages and shelves were designed for our purposes. In addition, we have endeavored to avoid unnecessary noises and rough handling.

Our stock of animals came originally from the Sprague-Dawley Laboratories. From these original animals we have bred our own with 2 closed lines of random-bred animals and 2 lines of brother-sister meetings.

In the beginning, as in other rat colonies, there was a high incidence of respiratory disease, which now has practically been eliminated. This was done by Dr. Benjamin N. Berg, who destroyed all obviously infected animals and all suspected of having respiratory infection, as well as those which failed to gain weight in a normal manner. Thereafter, with a colony nearly free from respiratory disease, we have been able to study the onset of lesions of other diseases without the complication of pulmonary infection.

As our animals become older and reach a moribund state, they are killed and given complete autopsies. The data obtained are carefully tabulated so that we have been able to determine the relationship between age and the onset of lesions of various types and to study the development of these lesions from early to severe stages.

We have recently published a study of the data on five major diseases in male rats (Simms and Berg, in the *Journal of Gerontology* 12: 244–252, 1957). Findings show that for each of these diseases the onset of the early lesion gives a sigmoid curve when plotted against age, but the shape of the sigmoid curve depends upon the type of lesion. For example, myocardial degeneration has a relatively flat curve. This disease is first seen in some of the animals as early as 200 days of age, but a period of 900 more days elapses before the curve levels off with no further incidence. On the other hand, degeneration of voluntary muscle is not seen until 550 days of age, but the curve rises so sharply that there is a 100 percent incidence after only 550 more days.

With some diseases, such as periarteritis, only a portion of the animals are susceptible. The remainder are apparently immune to this disease, with the result that the sigmoid curve levels off at 60 percent incidence. Similarly, adenoma of the pituitary is found in less than 25 percent of the older animals, but all those susceptible acquire this tumor before 900 days.

The logarithmic increase in the human death rate with advancing age, first reported by Gompertz in 1825, has been a matter of concern for many years. The reason for the logarithmic increase has not previously been explained. Our data on rats show that their mortality follows a similar but very much steeper logarithmic curve. We have been able to show that this is not due to a change with age in the duration of the diseases from early to late stages but rather because the mortality parallels the onset of the major diseases that contribute to the death of these animals. As was stated above, the onset of these major diseases has a typical sigmoid curve. We have found, furthermore, that the probability of onset of new lesions of each disease when plotted against age gives a curve with a definite peak suggestive of a normal distribution curve. In other words, for each disease there is an age of maximum probability of acquiring a new lesion of this disease, and the resulting mortality follows a logarithmic curve, like the human mortality curves with which we are familiar.

—Henry S. Simms, Ph.D., *Columbia University College of Physicians and Surgeons, New York City.* *(This study was carried out on grants from the Josiah Macy, Jr. Foundation and the Albert and Mary Lasker Foundation, and grant H–945 from the Public Health Service.)*

Evaluation and Treatment of Older Persons in Need of Psychiatric Care in a Metropolitan Area

By current standards, mental disorder is common, and emotional ills, by some definition, affect everyone. However, circumstances often dictate that treatment be reserved for disturbed and disturbing persons who need specialized care for their welfare or that of society. Even for them there may be limited resources. Obviously, not all psychiatrically ill older persons reach points of medical care. Of those

who do, not all are equally afflicted; many who receive good care may require it less than some who receive little or none.

Where psychotherapy is regarded as a luxury, psychiatric disorders will not be identified; where the needs for physical care remain unrecognized because of socioeconomic circumstances, frank illness and associated emotional disturbance may pass for physiological decline. If we are to provide services for aged persons to match their real needs for medical care by present-day standards, the way inequalities in the distribution or receipt of care come about must be studied, especially where governmental or charitable agencies are instrumental in providing these benefits. A knowledge of the characteristics of persons now receiving different types or gradations of sociomedical treatment may permit inference or clarification of how they were selected for care or suggest preventive measures.

As part of a preliminary survey for the New York State Department of Mental Hygiene, more than 600 persons 65 years of age or over selected at random from nursing homes, old-age homes, and State hospitals were examined for comparison of their physical and mental functioning. The nursing home population was in the poorest condition from the point of view of physical function, while persons in the homes for the aged functioned best. Those in State hospitals were intermediate. About 40 percent of the aged first admissions to a hospital who survived the first 3 months required active medical care. New admissions to the State hospitals were in the poorest physical condition of all. Aged persons readmitted to the State hospitals for disorders developed in early years were generally in good physical condition.

Advanced age and physical disability tended to go hand in hand in State hospitals and in homes for the aged; nursing home residents showed the same degree of disability at all ages. Persons beyond the age of 75 appeared to have physical disability with equal frequency in all institutions. Patients in the best physical condition did best on tests of mental status as indicated by comparison of the institutional population.

Two hundred and ninety-three subjects 65 years and older selected on a random basis from the variety of nursing and old-age homes were tested by M. Pollack and R. Kahn for the capacity to perceive properly simultaneous tactile stimuli to the face and hand. About half of the subjects made persistent errors. The results exactly paralleled those of questionnaire examinations for mental status. The defects in perception were found in increasing numbers with advancing age and decreasing function but preponderantly in persons where early formal education was absent or scant.

The institutions studied were relatively homogeneous both as to the background of their residents and to the general level of alertness of the residents. There are apparently interpenetrating factors of selection which create an institutional milieu. Furthermore, these factors have a continued influence in maintaining the cultural milieu. The residents contribute to a culture which in turn acts upon them for better or worse. In this way, up to a point, the good institutions probably grow better and the poor grow worse.

The findings imply that disorders of perception related to disorientation and mental disorder in the aged are strongly influenced by cultural background and also are related to physical functional capacity. In our society good early education may act as a protection against decline of mental and physical functioning in the later years; it may help to provide special protective devices for oneself; or it may be an index for correlated protective factors. In all likelihood all these possibilities are true. The sequence may be: poor education contributes to socioeconomic deprivation, socioeconomic deprivation contributes to illness, illness to invalidism or impairment of function, impairment of function to mental disturbance, mental disturbance to disability or invalidism, and invalidism to socioeconomic deprivation.

Studies of this nature appear doomed to uncover the banal, but the manner in which the obvious is uncovered may suggest practical measures for prophylaxis and treatment. By inference, a large number of the mental disorders of the aged can be traced to economic and health problems of their preceding years. Good socioeconomic circumstances, good education

early in life, and the protection of physical health through the provision of social, public health, and general medical services promise to decrease the number of disoriented aged persons and the intensity of their disorders in the future. For those now ill, social rehabilitation techniques and good general medical treatment may mean the reclamation of a number of disoriented and maladjusted aged persons. Mutually damaging reciprocating relationships of person and institution should be interrupted; at times this requires no more than provision of the very important service for the protection of mental health: good medical care.

—ALVIN I. GOLDFARB, M.D., *office of the consultant on services for the aged, New York State Department of Mental Hygiene, Queens Village, N. Y.*

Age Differences in the Acquisition and Extinction of Conditioned Eyelid Responses

The eyeblink is difficult to condition in persons over 65 years of age, but when conditioned, is more resistant to extinction, according to a report by L. B. Gakkel and N. V. Zinina in the *Fiziologicheskii Zhurnal* (Moscow) in 1953. This report stimulated a study to provide systematic information on eyeblink conditioning and extinction among children and young and old adults under the same controlled conditions.

The subjects were 15 boys in the age range 8–10 years, with a mean age of 9.36 years; 15 young men aged 18–25 years (mean age 20.63 years); and 13 men aged 62–84 years (mean age 70.5 years). The old adults were noninstitutionalized and were either employed full time or part time or were retired.

The conditioned stimulus (CS) was an increase in the brightness of a 6-cm. circular milk glass disk from 1 to 1.5 apparent foot-candles. The duration of the CS on each trial was 1 second. The unconditioned stimulus (UCS) was a puff of air with an intensity of 2 pounds per square inch delivered to the right eye, with a duration of 500 milliseconds. All subjects were given 80 conditioning trials. Intertrial intervals were spaced at 10, 15, and 20 seconds according to a prearranged schedule. Following the 80th conditioning trial, 20 extinction trials were given in which the CS–UCS interval was lengthened to 1,500 milliseconds. Subjects were tested in a dark and relatively quiet room. The equipment for recording eyeblinks and presenting the CS and UCS was similar to that of K. W. Spence described in the *Journal of Experimental Psychology* in 1953.

Through the 60th conditioning trial, the conditioning curve for the children was consistently above that of the young adults, and it was above that of the elderly group throughout the entire 80 trials. The conditioning performance of the young and old adults was similar through the first 20 trials after which the young group improved markedly and the elderly group only slightly. The conditioning curve of the children was negatively accelerated, that of the young adult group was positively accelerated, while the curve of the old adults was flat. At the start of conditioning, either the performance level of the children or the rate of conditioning was relatively high or both were high. On the other hand, the performance level of the other two age groups at the beginning of conditioning was relatively low or the rate of conditioning was slow or both conditions prevailed.

Statistical evaluation of these results was made by the Mann-Whitney test. The difference between the number of conditioned responses made by the children and the old adults was significant beyond the .002 level of confidence for a two-tailed test ($U=23$). The difference between the number of conditioned responses made by the young adults and the old adults was also significant beyond the same level of confidence ($U=25$). The children and young adults did not differ significantly in the number of conditioned responses ($U=89$).

Resistance to extinction was also inversely related to age. The use of the Mann-Whitney test showed that the children made significantly more conditioned responses during extinction than the elderly adults ($U=27$; $P<.002$) as did the young adults ($U=49$, $P<.05$). The two younger groups did not differ significantly in this respect.

The main and striking finding of this study was the relative inability of the elderly sub-

jects to acquire the conditioned eyeblink response. Of the 13 subjects in this group, 4 subjects gave no conditioned responses during the 80 conditioning trials, 7 gave from 1 to 8, while 37 and 75 were given by the other 2 subjects. There were no instances of failure to condition in the two younger groups. This result confirms the report of Gakkel and Zinina although their study does not include data on the conditioning performance of younger subjects. To account for the failure of older subjects to condition, Gakkel and Zinina quote Pavlov as concluding that "liveliness of the nerve processes suffer(s) from the development of senile changes." They also invoke the construct of inertia of the stimulating process at senile age.

These results suggest the consideration of an adaptation hypothesis to account for the relative unconditionability of elder subjects. It is known that subjects who were adapted to the UCS (air puff) showed a significantly lower level of conditioned eyelid responses than subjects who were not given pre-adaptation trials. It is proposed that in the course of many years of living the eyelid response and probably other responses have been "adapted out" and thus are less susceptible to subsequent conditioning. Research is underway to study several consequences of this hypothesis: that both frequency and amplitude of blink are reduced as a function of age. The procedures employed in the present study did not provide data on these variables.

—Harry W. Braun, Ph.D., *professor of psychology, University of Pittsburgh.* (*This investigation was supported in part by research grant M-1365 from the National Institute of Mental Health, Public Health Service. Richard Geiselhart assisted in the study.*)

Cornell Longitudinal Study on Occupational Retirement

The Cornell study of occupational retirement is a longitudinal study of a panel of subjects, most of whom were born in 1887, 1888, or 1889. Currently, there are approximately 2,400 participants in this study; they do not constitute a representative sample in a statistical sense, but represent widely divergent backgrounds and all the geographic regions of the country, although the major concentration is from the more heavily industrialized sections. With the exception of a disproportionate number of professionals, the participants approximate the total male employed population from age 60 to 64. The investigators consider the population to represent the "normal aged."

In this preliminary analysis of findings from the study, the major independent variable is occupational status or the change in that status from worker to retiree. The dependent variables, adjustment, subjective health, and economic deprivation, approximate the Guttman scalar pattern. Emphasis is upon the incidence of changes among the persons who retire and those who continue in gainful employment.

Our data have not supported the hypothesis that, in general, retirement leads to a decline in adjustment. We have found that continued employment for some older persons may result in a decline in certain measures of adjustment equal to or greater than changes experienced by persons who retire. This general finding was confirmed by data from the two periods under analysis: 1952–54 and 1954–56.

Age identification as a measure of adjustment was also examined; the data suggest clearly that retirement does not result in a deterioration in age identification. The retired are no more likely to experience a decline in age identification than the gainfully employed.

We also examined the data on the relationship between the forms of retirement and adjustment and we noted that a person's attitude before retirement is a more influential factor affecting a person's adjustment than the circumstances surrounding retirement, that is, whether the decision was made by the person himself or his employer. Persons who have negative attitudes toward retirement are more likely to evidence inadequate adjustment in retirement than are those with positive attitudes before retirement.

By means of the longitudinal analysis, it was shown that the association between retirement and health is largely explained by the fact that people in poor health tend to retire and not that retirement affects health negatively. This

part of the analysis is based primarily upon self-appraisals of health; but the findings are substantiated by the analysis of objective changes in health, that is, ratings by examining physicians. As in other studies, we do find a higher incidence of relatively poor health among persons who have retired, but it would seem that this correlation can be understood in terms of poor health leading to retirement and not the reverse.

One of the most obvious and objective effects of retirement is economic, for it is the rare retiree who is able to maintain his preretirement income. However, it seems agreed by a number of students of retirement that objective income must be interpreted in terms of the needs and wants of the persons. The researcher studying retirement must be aware of the subjective aspects of income. In the Cornell study we developed a measure of what we call economic deprivation in order to determine changes in attitude regarding objective changes in economic status. The panel analysis shows clearly that retirement contributes to the development of economic deprivation. However, the data also indicate a perhaps more striking finding: a high proportion of retirees possess a sufficient "role flexibility" that enables them to adapt to a greatly reduced income.

One general conclusion from this study, of which a fuller report appears in a forthcoming issue of the *Journal of Social Issues*, is that longitudinal surveys of retirement can point to the need for reexamining some stereotyped ideas about the effects of retirement. There appears to be a wider range of adaptability and adjustment than is commonly thought.

—GORDON F. STREIB, PH.D., *professor of sociology, Cornell University.* *(Initially supported by funds from the Lilly Endowment, Inc., the study now continues through grants from the National Institute of Mental Health, Public Health Service. Contributions to the analysis were made by Dr. Wayne E. Thompson, assistant professor in Cornell's sociology and anthropology department.)*

New Sections of Excerpta Medica

Two new sections of *Excerpta Medica*, Rehabilitation (Section 19) and Gerontology and Geriatrics (Section 20) were begun in July 1958. Each is published monthly by the Excerpta Medica Foundation.

With the objective of "opening another avenue to aid the medical professions in this 20th century challenge, the conquest of disability," the Rehabilitation Section is devoted to experimental, clinical, and program aspects. The first issue contains 314 abstracts, arranged according to a preestablished classification system to facilitate reference. Publication of this section is aided by a grant from the Office of Vocational Rehabilitation, Department of Health, Education, and Welfare.

The new Gerontology and Geriatrics Section, aided by a grant from the Public Health Service, covers the whole field of aging and the aging process. Recognizing that the subject is of social as well as medical concern, it includes such topics as social behavior, social welfare, economics, and politics in addition to purely medical problems.

Public Health and Medicine exhibit

Brussels World Fair

J. STEWART HUNTER

AN EXHIBIT on public health and medicine in the United States was on display at the Brussels World Fair between August 18 and October 19, 1958. Housed in three buildings adjacent to the main American Pavilion, the exhibit was designed and built by the Public Health Service.

Mr. Hunter is Assistant to the Surgeon General for Information, Public Health Service. Mr. Hunter, William Thompson, assistant chief, Visual Aids Branch, Department of Health, Education, and Welfare, and Harry Wiener, visual information officer, Bureau of State Services, Public Health Service, formed the three-man team who conceived and built the exhibit in Brussels after some preliminary planning in the United States.

Its purpose was to tell the story of progress in American health during the past several decades with some emphasis, as well, on the unfinished tasks that lie ahead.

A display on American health was considered important for several reasons:

First, how a nation provides for the health of its people is a significant gauge of how that nation lives. In Dr. Howard Rusk's phrase, "The emphasis we place on dignity and service for our sick and handicapped is [also] a hallmark of life in America."

Second, the story of American accomplishments in health is exportable. Health techniques, methods, knowledge, and facilities developed in the United States are now being used in many parts of the world. We are al-

ready contributing substantially to health throughout the world, and President Eisenhower has suggested that we seek ways to increase that contribution.

The Brussels fair presented an opportunity to tell that story. The objective, therefore, was not only to show what we do in health and how we do it, but to illustrate the enormous potential which the export of American ideas and techniques in health holds for people in other nations.

Two further points about this exhibit should be mentioned. First, exhibits are not the only nor necessarily the best method of presenting American accomplishments in health to the world. All the techniques of public education and health information could—and should—be employed if we are to do a really significant job on the world scene.

Second, the Brussels exhibit cannot be considered a prototype of exhibits abroad. For example, it was necessary to fit the story into a physical structure designed for another purpose. From mid-April until mid-July the three buildings, used ultimately for the health display, had housed an exhibit on unfinished tasks in the United States, specifically on man in relationship to man, on man in relationship to nature, and on man in relationship to his environment. Moreover, events obliged us to design and develop most of the health exhibit on the spot within 3½ weeks.

Outside the public health and medicine exhibit at the Brussels World Fair are Dr. Leroy E. Burney, Surgeon General of the Public Health Service, and (*right*) Dr. Thurston J. Davies, executive director of the American Pavilion. The panel inscription, like all signs and captions in the pavilion, is in English, French, and Flemish.

The major problem in planning the exhibit was to encompass the tremendously varied and complex story of American health within manageable visual form. We started with several basic assumptions: (*a*) the story was not to be told chauvinistically but in a spirit of sensible candor which presented what has been done and what remains to be done in the United States; (*b*) the exhibit was to include as many elements of public health and medicine in this country as possible, rather than cover the work of a single profession, group, or institution, within or outside government; (*c*) because of its wide scope, the story had to be presented impressionistically rather than literally.

The decision was made, therefore, to classify health work in the United States under four broad areas of activity: prevention, treatment of the sick and disabled, medical and hospital care, and control of the environment.

To round out the story of American health which the exhibit simply outlined, we relied on a group of young American college students employed in the United States Pavilion to serve as guides, to answer questions, and to describe aspects of American life not fully pictured. These guides were thoroughly briefed and were given fact sheets which contained more detailed information than the displays included.

The theme of the entire exhibit was summed up in the opening panel of the first building:

"Better health is one of man's brightest dreams.

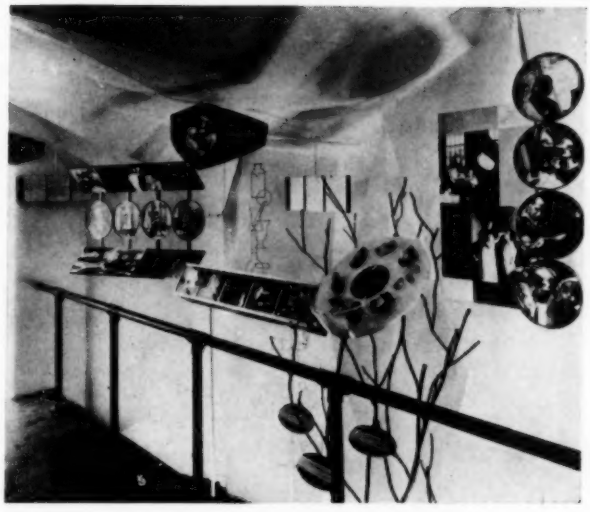
From the beginning, man has fought pestilence, disease, suffering, and premature death.

The face of the enemy is changing . . . from death-dealing scourges to diseases that maim and disable.

The weapons have changed . . . from nostrums to miraculous drugs and the skills of modern medicine.

The scene is changing . . . from the pace of rural life to the tempo of great cities.

But the struggle endures and better health



Photographs (*left*) illustrate hospital and medical care in the United States. Exhibit (*right*) traces the development of antibiotics from bread mold to the final product in the symbolic petri dish. Tree bears a quotation from Psalm 67, "The earth has yielded its increase . . ."

for each nation remains among mankind's great unfinished tasks.

This is a story of how the battle for better health is being carried on in America and something of the great challenges that lie ahead . . ."

The interior of the first building used the concept of a crumpled newspaper with headlines indicating some of our national problems in health and medicine. The nature of these problems was merely suggested by four photographs illustrating the broad fronts in the fight against illness: prevention, treatment, medical care, and control of the environment.

The second building was devoted to visual treatment of these four broad themes by specific examples which showed, not literally but impressionistically, America's accomplishments and future tasks. Throughout the accompanying text the linkage of medical science in the United States to the scientific accomplishments of other nations was indicated.

A summary of the present health status in the United States introduced the visitor to the second building. A light box containing a color photograph depicted in a series of 15-second flashing light sequences the average size of the various groups in the American family from 1900 to the present. The text pointed out that in 1900 a child at birth could expect to live 46 years; but in 1958, a child at birth can expect to live 67 years, or well into the 21st century.

Opposite the light box was a model of a beating heart, used as a symbol of health. The accompanying text pointed out that in the United States certain of mankind's ancient enemies have been conquered: malaria, typhoid fever, smallpox, diphtheria, pellagra. Others, however, remain: cancer, heart disease, arthritis, mental illness, dental diseases, and the problems of the modern environment.

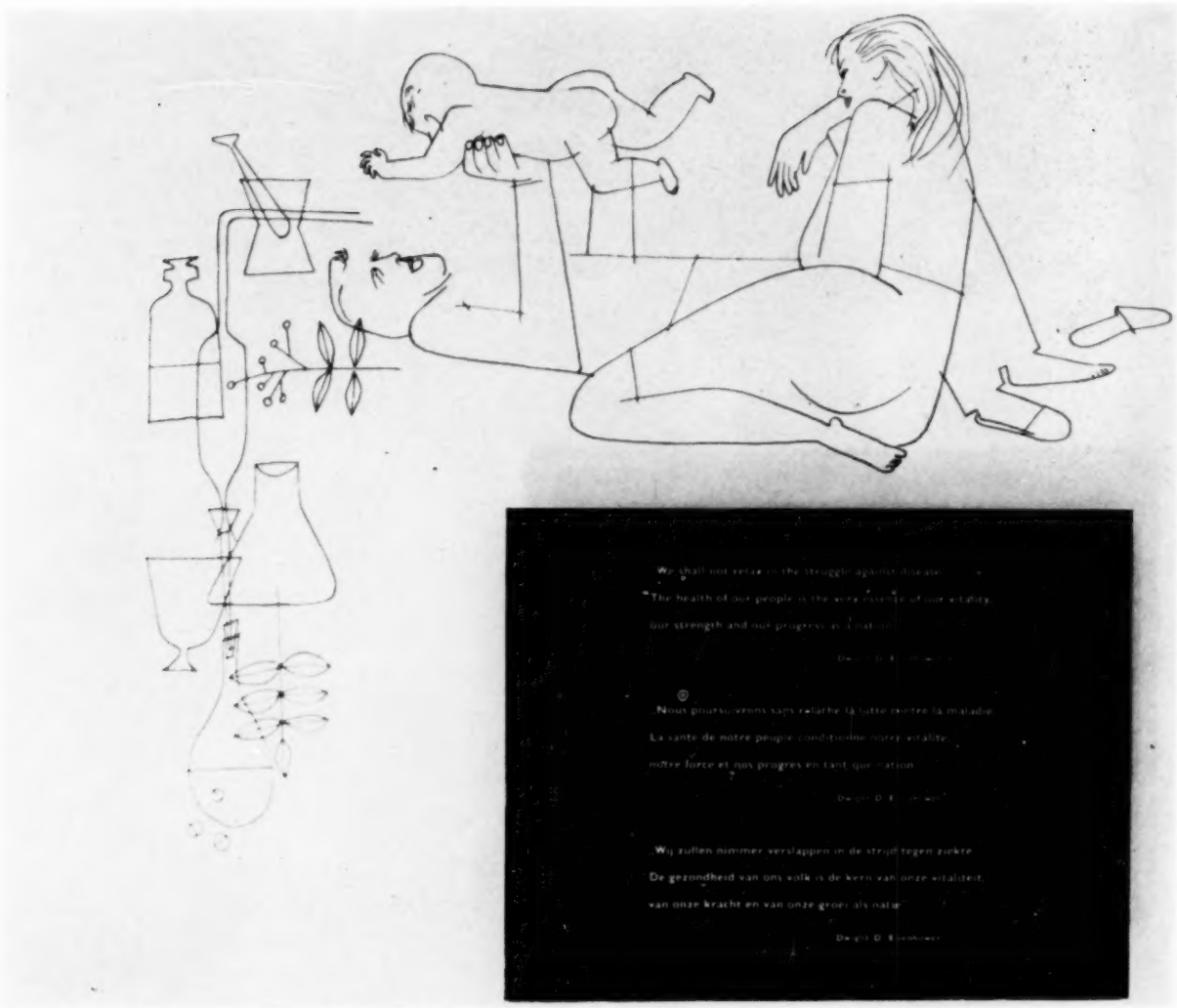
The section on prevention highlighted the development of the poliomyelitis vaccine, one American story which is well known throughout much of the world. Photographs traced the story from its beginning through research, trial, application, and results. A chart showed the Nation's progress against this disease during the past 4 years. The guides were asked to point out that within weeks after the vaccine proved successful, the United States made its formula known to all the nations of the world.

The Salk vaccine story also illustrated the promise of medical research. "Medical research," an accompanying legend read, "on which the U. S. currently spends over $400 million annually is a first line of defense. Through the work of scientists the world over, the dark mystery of cancer, the cause of heart disease, and other illnesses will one day be uncovered."

The guides pointed out that Congress, over the past 10 years, has voted increasing amounts for medical research, principally for grants to universities, medical schools, hospitals, and other research laboratories. Industry, univerities, and private foundations were credited with their part in this national endeavor.

The guides were coached to emphasize the international character of research, citing the long and illustrious list of scientists from dozens of nations who have contributed to American and world progress in health. This information permitted visitors to identify themselves and their countries with the march of health.

A series of photographs under the general heading of prevention demonstrated another phase of research and its application, the use



The health objectives of the United States were summed up in a quotation from President Eisenhower: "We shall not relax in the struggle against disease. The health of our people is the very essence of our vitality, our strength and our progress as a nation." The panel containing the statement in three languages was in the building devoted to health in the future.

of sodium fluoride to prevent dental caries. The fluoride story was chosen not only because it is illustrative of research applied to human health but also because of the wide prevalence of dental caries abroad and the fact that fluoridation of community water supplies is a simple, inexpensive method of cutting down measurably on such defects.

The section on treatment, also presented in terms of accomplishment and of challenge, illustrated the story of antibiotics. For the world of science the antibiotics are a triumph of research; for the United States they are a triumph, as well, of mass production methods. The exhibit showed the source of antibiotics, simple molds; how they are refined and mass produced; their tremendous variety; how they are administered; and the diseases against which they have been most effective.

The text stated: "In 1929, a brilliant English scientist, Sir Alexander Fleming, discovered penicillin. Since then, thousands of new drugs and many new medical techniques have given hope to millions and relieved untold human suffering. As long as needless deaths occur, medicine's great challenges remain."

The guides could again point out the international character of research and its infinite

promise for mankind. They were asked, for example, to tell visitors of the successful use of antibiotics against yaws in Haiti. Similarly, it was suggested that they mention the conquest of malaria in the United States, and the worldwide malaria eradication campaign now being undertaken through the World Health Organization.

The section on care covered rehabilitation of the ill or handicapped and American progress in developing hospital and medical facilities. "Hospitals are needed for a growing population," the accompanying text read, "and for the care of the elderly whose numbers, in America as in other lands, are steadily increasing. Funds voted by the Congress of the United States or contributed by individual Americans have built thousands of hospitals in recent years. More are being built; more are needed."

In this field, the guides were briefed on the steadily rising level of medical care in America brought about by research, new drugs, new methods of surgery, improved medical and public health practice, and perhaps most important and basic to this rise, the sustained public interest in the improvement of health. They were also given information on the accomplishments of the joint Federal-State-local hospital construction program and on the health and medical care problems of an aging population.

Among a wide range of possible subjects, two—water pollution and air pollution—which are common to industrialized nations, were chosen to illustrate control of the environment.

Two brief statements accompanied the pictures: "As great cities grow, so do the hazards of environment. Pittsburgh, Pa., America's 'smoky city,' has cleaned up its air. Both air and water pollution are unfinished tasks for other cities in the U. S. and throughout the world." And, "Wastes from industrial plants and over-taxed disposal systems in growing suburban areas contribute to polluted rivers. Many thousands of streams and lakes provide good clean water. The job of restoring many other rivers is a big one—a task in which American industry, local communities, and the Federal Government are cooperating."

Three "before and after" photographs of Pittsburgh illustrated accomplishments in reducing air pollution. The environment section provided an opportunity for the guides to discuss briefly other subjects such as sanitation, personal hygiene, the safety of water and milk supplies, and the safety and quality of food and drugs.

The third building suggested the world toward which we are moving, a world in which the great diseases will have yielded to the impact of research, control measures, better care of the ill and the handicapped, and increasing control over the environment.

An important part of this section showed the pattern in which health services are provided to the people of the United States. It is a partnership of the many: the health professions, voluntary agencies, universities and research centers, hospitals and clinics, citizens groups, and local, State, and Federal Governments.

America's health objectives for the future were summed up in two brief panels. The first panel contained a quotation from President Eisenhower: "We shall not relax in the struggle against disease. The health of our people is the very essence of our vitality, our strength and our progress as a nation."

This statement on the importance of health, equally relevant to all nations, sums up the value that Americans place on this intimately human need.

On the opposite panel there was a statement of objectives which embodies both the domestic ideal and the concept of America's role in relationship to other nations:

"To continue, through research and improved public health and medical practice, the fight against suffering and premature death in America . . .

"To help pursue, through the World Health Organization and other means, the search for a healthier world."

The increasing resistance to insecticides is threatening the impressive gains in control of vectorborne diseases. The Communicable Disease Center is studying the biological mechanisms of resistance and means of detecting and counteracting this phenomenon, and is providing technical assistance for other Federal agencies and the States.

Insect Resistance to Insecticides

R. J. HAMMERSTROM

SOME of the major achievements in public health since 1944 have been realized through the use of newer insecticides, beginning with DDT. Important vectorborne diseases, such as malaria, typhus fever, yellow fever, and insectborne enteric infections, have been controlled effectively in certain parts of the world and virtually eradicated in others through the use of insecticides. In the United States, for example, malaria is considered to be near eradication; endemic typhus fever morbidity has fallen from a peak of 5,401 reported cases in 1944 to an alltime low of about 100 cases annually. These phenomenal achievements in this country and elsewhere are attributed for the most part to the use of DDT.

The development of resistance to insecticides by many important disease vectors, however, threatens the continuation and extension of worldwide progress in the control of vectorborne diseases. For this reason, insect resistance is internationally recognized by leading health authorities as the most important problem facing organized vectorborne disease control programs today.

Mr. Hammerstrom, formerly deputy chief of the Technology Branch, Communicable Disease Center, Public Health Service, Atlanta, Ga., is now the regional sanitary engineer, International Cooperation Administration, Department of International Health, Lima, Peru. *This paper, with minor changes, was presented at the meeting of the United States-Mexico Border Public Health Association, April 8, 1958, in Juarez, Chihuahua, Mexico.*

Worldwide Significance

Resistance of houseflies to DDT was first noted in Italy in 1946. In immediately following years, the phenomenon was reported from other countries, including the United States in 1948. Resistance of houseflies to DDT led in subsequent years to the use of related chlorinated hydrocarbon insecticides, such as methoxychlor, TDE, lindane, chlordane, heptachlor, and dieldrin, with the result that resistance to these compounds also developed. Today, housefly resistance to DDT and to other chlorinated hydrocarbons is evident in practically all countries of the world. In some areas, including the United States, houseflies are beginning to show resistance to the more recently developed organic phosphorus compounds.

Mosquitoes began to show resistance to DDT at about the same time as houseflies. The first observations of resistance were reported for *Culex pipiens*, also in Italy. Resistance to DDT and other chlorinated hydrocarbons soon became evident in a number of species of culicine and anopheline mosquitoes in many countries. As with houseflies, certain species of mosquitoes are now resistant to some organic phosphorus compounds.

Resistance to insecticides on the part of insects of public health importance is by no means restricted to houseflies and mosquitoes; certain cockroaches, fleas, lice, and bugs are also resistant. There are now 44 species of vectors and pestiferous insects that are resistant to one or more insecticides (*1*). The geographic areas involved and the number and type of insecticides to which insects have become resistant are increasing steadily.

There are 26 species of resistant insects that are vectors of diseases such as malaria, yellow fever, encephalitis, diarrhea and dysentery, typhus, filariasis, dengue, and Chagas' disease. Nine species of anopheline vectors of malaria in 7 countries, including *Anopheles quadrimaculatus* in the United States, have been found resistent to one or more of the insecticides generally used in residual spraying of homes for malaria control.

The continued effectiveness of insecticides against malaria vectors is important to our ability to cope quickly with localized outbreaks of reintroduced infection and consequent possible spread of the disease. In the fight against insectborne enteric diseases, resistance in houseflies has necessitated the development of newer and more effective insecticidal measures and greater dependence on elimination of fly breeding. The rising standard of living in the United States, particularly since World War II, has been accompanied by rapid expansion in organized mosquito control programs and other types of community insect control activities. In addition, household use of insecticides in the United States has increased tremendously during this period. It is estimated that from $75 to $100 million is expended annually in America for chemical control of insects of public health importance. Resistance to insecticides, therefore, is an important consideration in both the effectiveness and cost of control activities.

CDC Investigations of Resistance

The Communicable Disease Center of the Public Health Service initiated laboratory and field investigations of insect resistance when the problem was first recognized. These continuing studies, conducted by the Technical Development Laboratories in Savannah, Ga., may be grouped as (*a*) fundamental investigations of the biological mechanism involved; (*b*) detection, measurement, and evaluation of the importance of insect resistance; and (*c*) development of remedial measures. Throughout the period of these studies, technical assistance has been given to other Federal agencies and the States.

Resistance may be defined as the ability of an insect population to withstand a toxicant to a greater degree than a normal population and to transmit this characteristic from one generation to another (*2*). Three types of biological mechanisms of insect resistance are generally recognized: (*a*) physiological mechanisms which enable insects to withstand or detoxify insecticides within their bodies, (*b*) morphological mechanisms which prevent a toxicant from entering the body, and (*c*) behavioristic mechanisms which permit changes in the insect's behavior patterns so as to avoid exposure to lethal dosages of insecticides. Studies conducted by the Communicable Disease Center have been concerned primarily with physiological and behavioristic mechanisms.

Physiological Resistance

In the CDC laboratory investigations of the physiological mechanism of resistance, strains of various insect species, principally houseflies and mosquitoes, are selected for resistance by exposure through a number of generations to a particular insecticide. Information on the mechanism of resistance then is obtained through studies of the absorption and metabolic fate of insecticides in both resistant and susceptible strains of the insect species.

Research is continuing on the physiological mechanism of resistance of houseflies to DDT and other chlorinated hydrocarbons and to certain organic phosphorus compounds. Results of these investigations have supported the finding that the cause of resistance to DDT is the conversion of DDT to DDE, a degradation product less toxic or harmless to the insect. This conversion process is effected through the action of an enzyme, DDT-dehydrochlorinase (*3*).

Physiological resistance in insects other than

houseflies also has been investigated. For example, the enzyme system involved in the degradation of DDT by DDT-resistant body lice has received some attention. The products of the metabolized DDT, however, have not yet been identified (*4*).

Colonization of a dieldrin-resistant strain of *A. quadrimaculatus* is underway in the laboratory, and the mechanisms of resistance to this insecticide will be studied when the resistant laboratory colony has been established.

Consideration of the subject of physiological resistance would not be complete without some mention of genetics in relation to the acquisition of resistance. It is generally recognized that more understanding of genetics is essential to explain how a population of susceptible insects can become resistant through exposure to insecticides. Limited genetic studies by CDC have included observations on the paterns of acquisition and loss of resistance in resistant houseflies. It is apparent that more than one pattern of resistance may arise from selection of a given strain and also that the pattern of resistance loss in partially reverted strains may not parallel the pattern of resistance acquisition.

Behavioristic Resistance

While changes in insect behavior patterns are recognized as a mechanism of resistance to insecticides, there have been relatively few confirmed cases of behavioristic resistance (*5*). The lack of a greater number of such cases is generally attributed to the paucity of studies and observations of insect behavior prior to the use of insecticides for control of the selected species involved.

Several examples of behavioristic resistance have been found in our work. As a result of reduced flight in the presence of DDT-synergist space-spray applications, resistant flies contact less spray than susceptible flies. Studies of the resting habits of flies in rural and urban areas have suggested that following exposure to residual DDT applications these insects changed their nocturnal resting places from indoors to outdoors during the warmer periods of the year (*6*, *7*).

In 1956, both behavioristic and physiological resistance to malathion was demonstrated in a strain of houseflies in the Savannah, Ga., area (*8*). This was the initial reported occurrence of resistance to malathion by houseflies in the United States. Following 12 weeks of effective control at a dairy with a malathion bait preparation (2 percent malathion at a dosage of 4 ounces of bait per 1,000 square feet of floor area), fly populations began to increase in spite of more frequent treatment and changes in types of bait formulations. Observations revealed that the flies were no longer attracted to the malathion baits, but actually appeared to be repelled by them. The majority of the flies approached the bait in flight but failed to alight on it: a true behavioristic response. Both the behavioristic and physiological types of resistance in this strain of houseflies were confirmed in subsequent laboratory and field studies (*9*).

In 1957, Schoof and Kilpatrick observed a similar pattern of behavioristic resistance in the Anderson strain of houseflies collected at a chicken ranch near Savannah, Ga. (*10*). Laboratory tests indicated that a colonized strain of this housefly was highly resistant to malathion and less susceptible to parathion and Diazinon than a standard laboratory strain.

The ecology and biology of both resistant and normal populations of vectors are important aspects of CDC's research on resistance. Studies are conducted of breeding requirements, biting and resting habits, and changes in life cycles or biotic potentials of resistant and susceptible strains. Such information is important in detecting and understanding behavioristic resistance and for developing and applying effective control measures.

Detecting and Measuring Resistance

One of the most important problems confronting those responsible for carrying out vector control programs is the early detection and measurement of resistance to insecticide in an insect species. Evidence of resistance is observed through reduced insect mortalities following the use of insecticidal formulations and application techniques which previously provided effective control. Many factors other than resistance can influence the degree of con-

trol, and too frequently the failure to obtain control has been attributed to resistance when other factors were responsible.

A method and a kit have been recently developed for wide-scale use in detecting the presence and extent of resistance in adult mosquitoes in malaria and other control programs. Such a method, if standardized, would also provide a valuable means of measuring in the field the susceptibility levels of various species of mosquitoes. The testing apparatus is a modification of equipment developed earlier by Fay and associates (*11*). In general, the test procedure entails exposing adult mosquitoes to commercially prepared paper surfaces treated with formulations of DDT or dieldrin in Risella oil. Papers selected for use in the test kits provide surfaces of 0.25 to 4 percent DDT or 0.05 to 1.6 percent dieldrin to be used at specific exposure periods. Mortality is determined following a 24-hour holding period (*12*). The test procedure and kits are being evaluated in the field in the United States and in other countries.

The Technical Development Laboratories make every effort to keep up to date on the occurrence of insect resistance, especially in the United States. Instances of resistance that arise in the course of CDC's studies are investigated thoroughly. The finding of malathion resistance in a strain of houseflies in the vicinity of Savannah, Ga., in 1956 has already been described. In Bolivar County, Miss., in 1955, *A. quadrimaculatus* was found to be highly resistant to dieldrin. Followup laboratory studies indicated that this strain also was highly resistant to BHC and chlordane (*13*). This finding represented the first detection of resistance in *A. quadrimaculatus* to chlorinated hydrocarbon insecticides in the United States.

Information on reported or suspected insect resistance is received from State health departments, mosquito abatement districts, agricultural agencies, research institutions, and other sources in this country. These reports are studied carefully with such followup inquiries as may be necessary to ascertain whether or not the resistance actually has been confirmed on the basis of experimental data. In some instances, the Technical Development Laboratories have confirmed specimens submitted from the field. For example, laboratory studies recently have been conducted on a colonized strain of housefly against which both malathion and Diazinon became ineffective at a dairy in Phoenix, Ariz. (*10*). This strain had been successfully controlled with malathion from 1954 to July 1956, at which time Diazinon was substituted for malathion because of inadequate control. Effective control again was achieved until June 1957. Topical applications of malathion, Diazinon, and parathion at CDC's laboratories indicated the strain to be resistant to all three compounds.

Technical Assistance

In addition to laboratory confirmation of suspected resistance in field operations, technical assistance is available from CDC's State Aids Section to State and local health departments and other organizations concerned in determining or confirming the presence of resistance in an insect species. In the past few years, a number of such requests from States have been met. Currently used and other available insecticides have been evaluated in field operations, and changes in control measures have been recommended.

While additional knowledge on the mechanism of resistance is being gained through research, the necessity of combating the present problem requires continuing studies for the discovery and development of new and improved insecticides and methods for their use. CDC is conducting laboratory and field tests to evaluate the insecticidal activity of experimental and available commercial compounds against both susceptible and resistant strains of arthropods. Both recognized arthropod vectors of disease and those species generally regarded as pestiferous are used in such tests. Principal attention is given to insects indigenous to the United States, but resistant strains from other countries are also tested. Such tests not only determine the most effective commercial compounds but also are used in the development of new and improved insecticidal materials.

For the control of houseflies, DDT and other chlorinated hydrocarbons are being evaluated as larvicides and also as adulticides in the form of residual deposits and space sprays. Or-

ganic phosphorus compounds are being studied as larvicides and as adulticides in the form of residual treatment and poisoned bait. One of the more significant developments in recent years has been the discovery of DDVP, which is being used widely in poisoned baits (*14*). Another valuable contribution has been the development of impregnated cords using organic phosphorus compounds, such as parathion and Diazinon, as residual insecticides for housefly control (*15*, *16*). In the development of new and improved insecticidal formulations, attention is given to the combination of insecticides and to the use of synergists, additives, and attractants.

Similar research is being done on the use of various chlorinated hydrocarbon and organic phosphorus insecticides and methods of application for mosquito control. Here again, the objective is to develop improved formulations and techniques necessitated, in part, by resistance. In recent years, attention has been directed to preflood and postflood treatment of irrigated areas for control of ricefield and other irrigation mosquitoes, residual larviciding against a variety of anopheline and culicine species, and fogging and barrier strip spraying for control of salt-marsh mosquitoes. In addition to laboratory and field investigations of improved insecticides and application techniques for the control of flies and mosquitoes, more limited studies of a similar nature are made on the control of cockroaches, fleas, and other insects.

The results of these investigations have been summarized as recommendations in CDC's annual report of public health pesticides, which for the past several years has been published in the March issue of *Pest Control*. This report, which also includes current data from the literature and unpublished data from other research organizations, is a valuable source of up-to-date information on the control of both resistant and susceptible insects of public health importance.

The growing problem of resistance has necessitated reemphasizing time-honored and proved methods of prevention and control of insect breeding through sanitation and other environmental measures. No insect has developed or ever will develop resistance to the elimination of its breeding area. Consequently, more attention is and will continue to be devoted to improved sanitation practices for prevention of housefly breeding and to drainage, filling, diking, and improved water management practices as a permanent means of eliminating mosquito breeding. The Communicable Disease Center supports this philosophy and is directing much of its research and technical assistance activities to that end. Research is being conducted at Savannah, Ga., and at Chandler, Ariz., on composting as an effective means of refuse disposal. In many areas of the western United States, CDC's Encephalitis Section is investigating improved methods of water management as a basic approach to the prevention and control of mosquitoes associated with irrigation and other water resource developments. In the cooperative community vector control demonstration projects in which CDC is participating, emphasis is placed on permanent sanitation improvements, such as better refuse storage, collection, and disposal, elimination of privies, and improved sanitation of animal pens, as a means of effective vector control. Insecticides are used on these projects only as a supplemental measure and then with due regard to insect resistance.

While I have discussed primarily the CDC research and technical assistance activities in connection with insect resistance, I realize that the question naturally arises, What can a member of a State or local health department do? First of all, he can stimulate broader recognition among health authorities of the growing importance of this problem. He can become more familiar with and support research activity, not only in this country but on a global basis, to overcome or combat insect resistance. All can be alert to the reported or observed instances of resistance in local areas and make this information known to those who are interested, and that includes the Communicable Disease Center. For those who are engaged in operational programs, particularly the control of mosquitoes, available field tests should be employed to detect early resistance to effect both economy and adequacy of control. Finally, improved sanitation and other environmental measures can be applied.

Conclusion

Insect resistance to insecticides should concern all public health workers and especially those engaged in the control of vectorborne diseases. Resistance is increasing more rapidly than research can develop ways and means of preventing or combating it. In the United States, Federal agencies, universities, and private research laboratories are conducting research on insect resistance. The Communicable Disease Center will continue its research and technical assistance activities following leads from current studies as well as any new approaches that may be indicated, and it will continue to work closely with State and local public health officials and other personnel engaged in insect control activities.

With these resources and with increased support through greater recognition and appreciation of the insect resistance problem, ways will be found to protect and advance the progress that has been achieved in the control of insects of public health importance.

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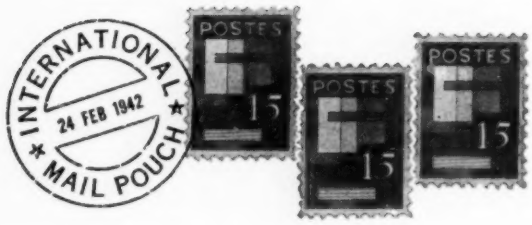


Women's Will

During the big dry season of 1957 in La Prosperité-Bersaba, a community of 260 persons in Surinam, the usual sources of water, rain barrels and Coropina Creek, dwindled. The soil formed a hard crust. Cassava, ananas (pineapples), bacove (eating bananas), napie (a sweet potatolike root), and gember (ginger) grew poorly. There were few crops to take to market along the railroad track, a 15-minute walk from the village, or in the town of Republiek, 30 minutes away.

Mothers of La Prosperité-Bersaba, shepherding their children to Republiek's consultatiebureau, heard how other villages were working together to get wells. The women decided to do something about their own community's plight and asked for a well.

Their request surprised the Surinaams Amerikaans Bureau Technische Samenwerking, because their village had previously been unenthusiastic about the bureau's well demonstration program. Now everyone wanted to talk to the health education assistant, the public health nursing trainees, and the sanitary inspector. They even stayed home from their kostground (fields) to be sure they would not miss seeing these people.

At a community meeting, they selected 3 men and 2 women to visit with the sanitary inspector to see what other villages had done. They also chose one of their most dependable citizens to supervise the voluntary crew that would work on their village well.

When the train brought the materials, everyone went to work, rolling the big concrete sections of pipe over the path to the well site, and bringing sand, gravel, and cement in wheelbarrows, baskets, and pails. Digging in the parched, sun-hardened earth was exhausting, but the well grew deep enough to insure a supply of water even in the long dry season. Several nights the work went on by lantern light.

Two weeks from the day the materials were unloaded, the well was finished. On November 1, 1957, La Prosperité-Bersaba proudly dedicated its new well.

—HILDRUS A. POINDEXTER, *chief public health officer, U. S. Operations Mission, Surinam.*

Potent Water

The well in Sunchon, Cholla Namdo Province, Korea, built with materials supplied through our sanitation program, has acquired an unexpected reputation. While I was inspecting the well soon after it was completed, a woman thanked me so effusively I wondered what had brought about such profound gratitude. I learned she had had seven daughters in succession, but after drinking water from the new well had given birth to her first son, to the delight of her family and the entire community.

—WALDO E. SMITH, *sanitation adviser, U. S. Operations Mission, Korea.*

Urban Improvement

A local sanitary inspector stimulated the cleanup of one of the older sections of Santa Cruz, Bolivia. He found 200 of the 280 homes lacked a potable water supply, and the 1,745 residents had only 11 latrines, all substandard. Garbage was thrown into the streets for animals to devour or the rains to wash away.

The sanitary inspector organized a health and sanitation committee among the residents. The committee surveyed the area and, with help from the local health center, started community meetings with discussions, films, and talks.

Enthusiasm and community pride led to the construction of a public well and 221 latrines. Streets were cleaned and graded, and nearly all the families began burning or burying their garbage. The residents themselves did all the work and provided the materials, except for a handpump and its accessories.

At the public dedication of the well, citizens from nearby sections of the city were so impressed that they asked the health center to help them make similar improvements in their own neighborhoods.

—HARALD S. FREDERIKSEN, M.D., *chief, Health and Sanitation Division, U. S. Operations Mission, Bolivia.*

United States-Mexico Border Public Health Association

Asociación Fronteriza Mexicana-Estadounidense de Salubridad

The active sharing of experiences, knowledge, and ideas, each year enriching the partnership between the United States and Mexico for better health along the border, was continued this year at the 16th annual meeting of the United States-Mexico Border Public Health Association in El Paso, Tex., and Juárez, Chihuahua. From April 7 through 11, 1958, the discussions took stock of progress, drew patterns for future action, and reviewed pioneering techniques. Presiding over this year's meeting was Dr. Malcolm Merrill, director of the State of California Department of Public Health. The President-elect is Alberto Ortiz Irigoyen, director of Potable Water Construction in the Mexican Ministry of Hydraulic Resources. Summaries of selected papers presented at the meeting appear on the following pages.

International Health Aims Translated Into Action

As chairman of one session of the U. S.-Mexico Border Public Health Association meeting in El Paso, Dr. David E. Price, Assistant Surgeon General of the Public Health Service, commended the work of border cities in developing water and sewage facilities, work carried out with aid from the International Boundary and Water Commission and the Mexican Government's *Recursos Hidraulicos*. Specifically, he mentioned sewage facilities in Douglas, Ariz., and Agua Prieta, Sonora, and in the sister cities of Nogales.

Price also paid tribute to the Mexican Ministry of Health and Welfare for its impressive malaria eradication campaign.

Among examples of contributions to border health programs made by the Pan American Sanitary Bureau, Regional Office for the Americas of the World Health Organization, Price cited the multilingual venereal disease reporting form for international exchange of information on contacts, which is now being adapted for domestic use throughout Mexico and the United States. Together with United States Federal, State, and local health agencies, the bureau is also seeking the optimum means of reporting tuberculosis suspects found through the border X-ray program.

Turning to activities of the United States Indian health program with bearing on border health, he sketched briefly the confused citizenship and residence pattern of the Papagos, almost all of whom have relatives and therefore frequent contacts across the border. Tra-

choma, diarrhea, dysentery, the communicable diseases of childhood, and impetigo are the current challenges among these people, he said, suggesting that exploratory conversations between officials of the Division of Indian Health of the U. S. Public Health Service and their Mexican colleagues might produce improved coordination in work for such tribes.

Another activity he touched on was the study carried out jointly by the Communicable Disease Center, Public Health Service, the Mexican Ministry of Health, PASB, and border States on insectivorous bats, which on occasion infect man. A station has been set up by the Service in Las Cruces, N. Mex., to unravel the puzzling epidemiology of rabies among these bats, of which the Mexican freetailed bat is the predominant species.

He also mentioned Communicable Disease Center studies and demonstrations in enteric disease vector control, coccidioidomycosis, and encephalitis, as well as training programs.

Price concluded with remarks on the international ramifications of research at the National Institutes of Health of the Public Health Service. There are several Mexican participants in the current program, but he wondered whether those most concerned with border health were fully utilizing grant resources. He affirmed the great interest of the Public Health Service in the border area, where, he feels, the philosophy of international health is translated into action.

Urges More Casefinding For Congenital Syphilis

Discussing the methods of finding cases of syphilis among pregnant women, Dr. Edith P. Sappington, regional medical director for the Children's Bureau, San Francisco, Calif., declared that all too many women receive no prenatal care until the second or third trimester. Moreover, though most hospitals give serologic tests for syphilis on all admissions, the cases found are either lost or followed with difficulty because low-income mothers stay in the hospital so briefly.

She advocated wider application of a second test for pregnant women during the third trimester, at least where there is a high prevalence of syphilis, referring to the suggestion that certain patients, such as those in lower socioeconomic groups, unwed mothers, and welfare hospital patients, should have two or more tests during pregnancy.

To bolster casefinding during the infant and preschool period, Sappington suggested that hospital records of mothers of children entering child health conferences be checked for evidence of serologic tests for syphilis. Mothers delivered by midwives might be routinely tested at the conferences. Though laborious, these methods she feels are justified, since congenital syphilis has not decreased in the past 2 years.

Maternal and child health programs also could incorporate such testing into school physical examinations, she added.

Sappington also pointed to the desirability of integrated health care for all members of a family. If all went to a single physician or clinic, congenital syphilis would not easily escape detection.

Reviews Clinical Aspects Of Congenital Syphilis

During the past 12 years, the cases of congenital syphilis reported annually in the United States have fallen only by 50 percent, compared with a drop of more than 90 percent in acquired early syphilis. This was pointed out by Dr. Willie G. Simpson, assistant chief, Venereal Disease Branch, Communicable Disease Center, Public Health Service, Atlanta, Ga., who feels that the current incidence of congenital syphilis is excessive in the light of the availability of penicillin.

Simpson described the clinical aspects of congenital syphilis in considerable detail. In his comments, he mentioned:

- In the early stages of congenital syphilis, demonstrable lesions may be absent, but they usually appear in the first 2 to 3 months of life if not already present at birth. Bone changes occur within the first 6 weeks, compared with scurvy changes after 6 months, and rachitic changes between the 8th and 18th months.
- In diagnosing asymptomatic congenital syphilis in the newborn, only an increasing titer and positive serology at 3 months of age are significant. Before then, reagin found in serology tests may be from the mother. Conversely, infants with negative serology but diseased mothers should be followed up for at least 3 months. Syphilis may be suspected at birth if the serology report shows a higher titer than for the mother at the time.
- Since adults with the congenital disease will be seropositive long after treatment, retreatment should be based on definite signs of relapse.
- A higher rate of seronegativity is attained in those treated during the first year of life, than in those treated later, regardless of the amount of penicillin given above the minimum adequate dosage. The patterns of response resemble those for treatment of acquired early syphilis and during latency after 2 years of infection respectively.
- Treponemal antigen tests are valuable in cases of clinically suspected congenital syphilis with reactive or nonreactive reagin tests.

VD Control Intensified In Bracero Home Areas

In the home states of most of the braceros, the Mexican Ministry of Health and Welfare has broadened efforts to gather venereal disease data, to test prospective agricultural migrant workers serologically, and to treat those infected.

Other aspects of the Mexican Government's drive against venereal disease described by Dr. Antonio Campos Salas, chief of the Ministry's campaign against venereal diseases, have also been expanded. In spite of a general downward trend in syphilis mortality and morbidity in Mexico since 1948, he said,

the disease was fifth among registered communicable diseases in 1957. He also pointed out that there were considerable numbers of recently infected as well as untreated persons and some cases with high indexes of positive serology.

The great majority of cases of venereal disease in Mexico are latent, he asserted. For that reason, serologic test laboratories and equipment have been augmented. Measures have also been taken to standardize and coordinate serologic test reports from all sources, and to make VDRL antigens available to all national laboratories. Training, briefing, and specialized instruction for the venereal disease campaign have been emphasized for personnel of medical agencies and institutions, private physicians, and community leaders, on whom the Ministry depends heavily in this drive.

As a public education device supplementing posters, pamphlets, and lectures, a film was produced in color and exhibited in leading cities. Campos Salas remarked on the growing facility in organizing public meetings for campaign purposes.

Venereal Disease Control Progress Report

In presenting the United States program in venereal disease control, Dr. William J. Brown, chief of the Venereal Disease Branch, Public Health Service, reported that in the United States the rate for syphilis has dropped from 447 to 81 per 100,000 population since 1943, the year penicillin came into use.

Although institutional care of the syphilitic insane still costs an estimated $46 million a year, over a 10-year period first admissions of such patients have dropped from 7,000 to 2,150 annually.

In the past 6 years, an increasing number of States have been reporting more early syphilis. Reported cases of primary and secondary syphilis are 11 percent higher this year than last. Gonorrhea rates, at the same time, have shown little change. An alarming percentage of venereal disease is being found in young people. Many infectious disease cases treated by private physicians are not being interviewed for sex contacts.

Brown reviewed the following current developments:

- Rapid plasma reagin test is revolutionizing the testing of migrant laborers. Immediate diagnosis and treatment prevents spread of infection and returns the once infected person to work without delay.
- Reiter protein complement fixation test, a specific treponemal test for diagnosticians, promises important savings in costs.
- Fluorescent antibody tests for both syphilis and gonorrhea may eventually provide rapid and inexpensive methods of detection.
- A casefinding procedure called "cluster testing" covering friends and associates of infected persons as well as sexual contacts may double the epidemiological yield.
- The training of 1,500 public health workers in 1957 by the Public Health Service is promoting more effective interviewing techniques.
- Epidemiological services to patients of private physicians have been demonstrated as a practical control measure and are being extended to many areas.
- A uniform report form for reporting venereal disease contacts and suspects in the United States has been developed, and many State health departments are considering its adoption in the interest of standardization of interstate routing of the forms.

New Mexico Aims To Stop Primary VD Infection

During the first quarter of 1958, accelerated casefinding in New Mexico was a factor in a 193 percent rise in reported syphilis and a 166 percent increase in reported gonorrhea, over the same period in 1957, according to members of the New Mexico Department of Public Health: Dr. Arthur D'Jang, director of the division of chronic disease, Dawson T. Kilcrease, health program representative in the division of venereal disease, Marion McBreen, associate bacteriologist, public health laboratory, and Dr. Stanley J. Leland, State director.

The effectiveness of the State's program, they said, is indicated by the rate of first admissions to State mental hospitals for all psychoses due to syphilis in 1955: it was 0.7 per 100,000 population, lower than the mean rate for continental United States.

Program Highlights

A confidential survey of physicians in New Mexico conducted in October 1957 revealed 640 more cases of venereal disease than were obtained from morbidity reports in the first 6 months of 1957. To stimulate reporting, the department devised a private physician's information packet with suggested treatment schedules, health education materials, evaluation of serologic reactions, and an interpretation of the new treponemal tests. Also offered was medicine for the physician's indigent patients.

Besides following up about 85 percent of the reported reactive serologic tests for syphilis and investigating 97.6 percent of reactors among braceros, the department trained several Navajo Indians and employed them as venereal disease investigators. Although Indians represent 5 percent of the people in the State, they contributed about 50 percent of the morbidity from venereal disease in 1957. In a survey including inmates of 4 prisons in the Navajo training experimental health district, a total of 2,129 serologic tests were made from June 1957 through February 1958. Navajos accounted for 96 percent of those tested. In the Navajo group, 10.1 percent were reactors, compared with 7.1 for the others.

Serologic Test Laws

Premarital serologic tests are required by a law passed in May 1957 in New Mexico, they said. Another law approved in 1949 requires all pregnant women to be tested for syphilis before delivery.

A serologic test is incorporated in a multiphasic survey among school and college students and teachers

and among industrial workers. During a migrant survey in 1957, a mobile unit with laboratory facilities was used, and another unit added in 1958 provided medical facilities for sparse population areas.

Three more programs were begun during 1957–58: the rapid plasma reagin test, the unheated serum reagin test, and the mass Frei skin test.

In reviewing phases of the control program, D'Jang and associates drew attention to the emphasis on primary prevention of venereal diseases, through health and sex education in schools and clubs; prophylaxis instruction in defense installations; provision of recreational facilities; and suppression of prostitution. They underlined the value of facilities for early diagnosis and treatment, believing that the cooperation of the public rests not only on mass education about symptoms and modes of spread but on the availability of diagnosis and treatment facilities without respect to the infected patient's economic status.

Los Angeles District Surveyed for MCH Needs

Two maternal and child health surveys carried out in the Northeast Health District of Los Angeles, Calif., during 1956 were reported by Dr. Stella B. Soroker, district health officer, and Thelma Herold, health educator, Los Angeles City Health Department.

Health problems in Boyle and Lincoln Heights, the survey sites, resemble those on the border, they explained. These sections have more residents of Mexican origin or descent than any border city. The northeastern area, moreover, is a port of entry for Mexican arrivals.

Citing statistics depicting needs of these areas, especially with respect to infant mortality, they said that, because of extraordinary mobility of the population, newcomers are often unaware of local health resources. During 1955 one-third of the prenatal cases and one-half of the newborn received some health department supervision. The MCH surveys sought to determine the gaps in health care for those unreached and reasons for the gaps.

Boyle Heights Survey

With volunteers from local societies, a hospital, and a junior college, the department began interviewing 500 to 600 Boyle Heights families with babies born during February through April 1955.

The interviewers found that of 232 families reached out of 662 families with children born a year before, 66 percent knew of MCH facilities and 87 percent of the mothers had received prenatal care. No protection against diphtheria, whooping cough, and tetanus was given to 22 percent of the 1-year-old population; 35 percent were not vaccinated against smallpox; and 9 percent had no health supervision. Sixty-eight percent of the families interviewed knew of services and locations of well-baby clinics.

Among reasons for not seeking protection from childhood diseases were lack of information as to the need or availability of services, indifference, and parental fear.

It was also ascertained that by 1 year of age, respiratory diseases accounted for 40 percent of conditions needing medical care, and accidents, 11 percent.

The health department recommended intensifying efforts to reach newcomers through publicity, nursing visits, and civic and religious organizations, stressing accident prevention among younger age groups, and conducting Red Cross classes for expectant parents.

Lincoln Heights Survey

In Lincoln Heights, they said, a newly formed committee of community leaders, PTA delegates, and professional persons, aided by volunteer residents, interviewed 275 families with children between 2 and 5 years old. Sampling required visiting 15 out of 100 households.

Applying the findings to the approximate total of 3,000 preschool children in the area, they estimated that 82 percent are protected against diphtheria, whooping cough, and tetanus, 71 percent against smallpox, and 48 percent against poliomyelitis. Sixty-nine percent of the families knew about the well-baby clinics, and the reasons for not seeking protective services matched those in Boyle Heights.

Outlines Health Agency Role In Chronic Disease Battle

Advances to be made in long-term patient care, in the opinion of Dr. Wilfred D. David, chief of Program Services, Chronic Disease Program, Public Health Service, will be closely bound up with progress in public health, medical care, and in developing adequate hospital facilities.

Prevention of certain diseases, he said, is the proper direction for many programs related to chronic ills and health needs of the aged. He remarked that preventive action is now possible for more than 50 chronic diseases. Preventive programs can stop or slow a disease's progress by early detection and early therapy, and can soften the economic and social effects of the disease for patient, family, and community.

He emphasized that these programs must be started by community initiative, be part of the total community health drive, and be spurred by health agency aid.

Types of activities of the Public Health Service in support of State and local programs named were training, consultation, dissemination of information, demonstrations, and technical assistance as well as regional seminars.

David suggested the following fields for community action: diabetes casefinding with referral for diagnosis, the techniques of which have been refined; diabetes patient instruction on diet, self-administration of insulin, and personal hygiene; glaucoma screening through tonometry performed by an ophthalmologist, with referral arrangements; restorative services for patients with cerebral vascular accidents; and improvement of nursing home facilities through consultation

and training of nursing home operators and aides.

In conclusion, he reported that many States have initiated new services for the aged and chronically ill through appropriations voted by Congress for that purpose in 1957.

About 30 percent of the population of the United States is 45 years of age or over, he noted, and 40 percent of the chronically ill are 65 years of age or more.

Isoniazid Reduces TB In Children

A year's work by the Public Health Service investigating the effect of isoniazid on 2,700 children with primary tuberculosis in the United States, Puerto Rico, Mexico, and Canada has presented physicians with a new method for control of this disease.

Dr. Edward T. Blomquist, chief of the Tuberculosis Program, Public Health Service, reported that among the children who have been taking isoniazid, the major complications of childhood tuberculosis have been practically eliminated. He advocated small daily doses of isoniazid for a year for infants who are tuberculin positive and those between 1 and 4 years old with X-ray evidence of the disease.

Another branch of the study will measure the prophylactic potential of isoniazid among older persons who, although not now exposed to tuberculosis, were infected in childhood. Evidence is accumulating, Blomquist said, that most new cases of clinical tuberculosis appear to occur among persons with subclinical infection which becomes active during stress or lowered resistance.

Care and supervision of nonhospitalized tuberculous patients must be expanded and strengthened by health departments, he feels, to meet the shift in emphasis from institutional to home care for tuberculosis patients. Health agencies, with their responsibility to protect the public from the disease, can do so by keeping active cases under care until noninfectious, with broadened clinical and nursing services, and by keeping information on nonhospitalized patients current. Their program, he concluded, must include diagnostic, treatment, and social services, as well as public health supervision.

Home TB Care Boon To Low-Budget Lands

For countries without ample means, ambulatory home care of tuberculosis patients, instead of hospital treatment, has opened up new horizons, stated Dr. Donato G. Alarcón, chief of the campaign against tuberculosis, Ministry of Health and Welfare, Mexico.

Together with modern medication, this therapy allows such countries to undertake broad campaigns against tuberculosis without dependence upon related social and economic factors. Mexico's mortality rate from tuberculosis, he said, has dropped from 69 per 100,000 population in 1930 to 38.

Describing the antituberculosis campaign in Acapulco (population, 50,000) as a low-cost pilot project, Alarcón reviewed results of 2 years' work there: 1,025 cases of active tuberculosis were discovered; 57.3 percent of school children 6 to 12 years old were found to have positive tuberculin reactions; and during the first year of the campaign, negative concentration smears were obtained for 70 percent of tuberculosis cases.

In the opinion of Alarcón and Dr. Salvador Roquet Perez, secretary of the Ministry's campaign against tuberculosis, consistent recovery of tuberculosis patients depends more on their economic status, education, and attitude toward the disease than on hospital facilities. They attributed to social and economic factors the fact that in a previous study 65 percent of the ambulatory patients who received thoracoplasty and pneumothorax were classified as arrested and later cured. These results compared favorably with results for long-hospitalized patients elsewhere.

Although home ambulatory treatment for tuberculosis has been endorsed, there is still a hospital shortage in Mexico. They concluded with details of Mexico's plans for expansion of tuberculosis hospital space in Mexico City, San Fernando, Monterrey, Tampico, and Xaltianguis.

Bovine TB Hazard Still Looms

Although tuberculosis in cattle has been reduced to 0.156 percent in the United States, dangerous foci of the infection remain. Dr. Donald Miller, veterinarian in charge, Animal Disease Eradication Division, Agricultural Research Service, U. S. Department of Agriculture, Phoenix, Ariz., stated that, during fiscal year 1957, 28.9 percent of cattle reacting to the tuberculin test showed gross lesions.

Eradication in Border States

In discussing eradication of the disease on the border, he described as essential the vigorous tracing by epidemiological means of herds of origin when infection is found postmortem at regular kill in a packing house. For example, the recent tracing of the source of such a lesion in Texas ended in finding 40 reactors in a herd of 139.

During fiscal year 1957, Texas had 611 reactors of which 22.8 percent showed gross lesions. In New Mexico, with a consistently low level of infection, reaccreditation will be tried for 6 years instead of the usual 3. Miller explained that reaccreditation may be given when infection is under one-half of 1 percent of area cattle tested. Arizona also has low incidence, due, in his opinion, to such measures as testing all dairy and purebred cattle and 20 percent of all pastured beef cattle every 3 years.

For California, faced with nonspecific reactions in certain herds and areas, Federal and State officials have developed trial testing procedures using intradermic tests with mammalian and avian tuberculins and johnin; cervical, caudal, and ophthalmic tests; and careful epidemiological studies and complete postmortems.

National Figures

Nationally, fiscal year 1957 was the third straight year with a slight infection rise, Miller said. Among 8,976,409 tuberculin-tested cattle infection appeared in 13,974. Of 14,054 reactors slaughtered, 319 carcasses, or 2.3 percent, were condemned.

Miller alluded to the lack of veterinary personnel in eradication programs. "This is no time for the veterinarians, health officials, and cattle growers to leave the field because we have a comfortable lead" he said. According to Miller, if we slacken in eradicating bovine tuberculosis, the progress of 10 years will be erased.

A Look Backward

Roughly 10 percent of tuberculosis in humans is of bovine origin, according to a study cited by Dr. Robert D. Courter, assistant chief, Veterinary Public Health Section, Communicable Disease Center, Public Health Service. But in areas with heavily infected herds the percentage is as high as 50.

About 378 million tuberculin tests have been made in cattle since the program's inception 40 years ago. Then, the program's harm to agriculture was prophesied, and the communicability of bovine tuberculosis to humans doubted. In fact, Koch, discoverer of the tubercle bacillus, was unconvinced of the need for protection against consumption of food from infected cattle.

Since antiquity, Courter related, man's attitude toward the disease has fluctuated between abhorrence and indifference. Eighteenth century laws levied drastic penalties, including exile, on those who sold meat of tuberculous cattle. Tuberculosis was then believed identical with syphilis, but when it was understood that the two diseases were not the same, aversions to such meat faded.

In the nineteenth century, he continued, when the infectious nature of tuberculosis was recognized, German veterinarians advised farmers to dispose of tuberculous animals and to cook milk before feeding young animals, presaging pasteurization decades later.

The effects of pasteurization and the reduction in bovine tuberculosis in the United States elude easy evaluation, in Courter's opinion. A commonly used index of progress in eradicating the disease is the fall in deaths from extrapulmonary forms of tuberculosis in humans. Since the drop in mortality from the pulmonary form has paralleled that from the extrapulmonary, he feels that such an index fails to consider effects of improved social and economic conditions and control measures among humans.

Four Polio Vaccine Doses Recommended in Mexico

Based on field observations, modification of the standard dosage plan for administering poliomyelitis vaccine was suggested for use in Mexico by Dr. Carlos Calderón, Dr. Carlos Ortiz Mariotte, Dr. Adán Ornelas Hernandez, and Dr. Louis Gutíerrez Villegas of the Mexican Ministry of Health and Welfare.

In a program administering Salk-type vaccine, which was carried out by the Ministry from October 1956 to December 1957 on about 221,000 children aged 6 months to 3 years, more than half of the observed poliomyelitis cases among those injected had onset from 1 to 3 months after the second dose. This led to the proposal that a dose be added from 1 to 3 months after the second, and that the reactivation dose be given 7 months later.

They found that the attack rate for those not immunized was at least 3 times higher than for children vaccinated; and among those immunized, the attack rate was higher, the fewer doses received.

Another observation was that among 150 blood specimens taken from children under 5 years old, only 10 percent of those from children having 3 doses were without antibodies. One-third from those not immunized showed antibodies, one-fourth having titrations of 1:64 or more. These results suggest that the vaccine stimulates antibody formation.

The vaccine, they explained, is made in Mexico using 2 parts, instead of 1, of type 1 strain, isolated in practically all cases of acute poliomyelitis in Mexico. Instead of Salk strains, those attenuated by Sabin are used. Studies carried out on about 5,000 children in 3 districts of high prevalence in 1956 and 1957 had already indicated the children's tolerance to the vaccine as well as its effectiveness. Further studies are recommended to test vaccine made in Mexico from strains used by Salk, they said.

Study Burial of Refuse As Curb on Flies

Whether prompt burial effectively inhibits fly emergence from refuse, which during collection in warm weather already abounds in fly eggs and larvae, was the subject of studies carried out by the bureau of vector control, California State Department of Public Health.

Ralph J. Black, senior vector control specialist with the department, reported that laboratory tests during the summer of 1955 showed that fly emergence was prevented if the soil was compacted at or near the optimum moisture content, in layers varying from 1⅝ inches to 2¼ inches deep. Houseflies emerged through 60 inches of uncompacted earth.

Conclusions from these and subsequent field tests underlined as essential factors soil that can be compacted, adequate range of soil moisture, suitable equipment for compacting, and adequate enough thickness of cover. Generally, sand, nearly pure clay, silt, and crushed rock do not compact well enough to prevent fly emergence, he said. Field moisture content of soil is adequate if a solid clod can be formed by hand squeezing. A bulldozer was suitable for soil compaction with repeated tracking over the cover material. When applying the earth cover, tractor operators must compact side slopes as well as the top cover to prevent fly emergence.

He estimates that, under field conditions, a 6-inch layer of compacted earth cover should prevent fly emergence.

Fly emergency traps can be used to determine the required thickness of cover and the amount of compactive effort necessary for local conditions. When the covering soil is not compacted, he said, flies can be reduced by quickly covering the refuse with a thin cover of soil to prevent more fly oviposition.

Reporting Aids Suggested In Diarrhea Seminar

Morbidity data on diarrheal disease, not officially reportable, can be gleaned from sampling surveys or from the evaluation of requests for services received by public health nurses, according to a recommendation emerging from the seminar on diarrheal diseases.

Participants stressed that in sections with a deficiency of health services, family cooperation is particularly important, even in reporting deaths. Therefore, health agencies were urged to convince families that their information will produce benefits in the form of health services. Since mortality reporting depends on competent diagnosis, it was agreed that improvement must develop locally.

Among needs mentioned to circulate and apply laboratory knowledge and resources were simplified, standardized laboratory methods and kits for shipping specimens.

Piping water into the home, as a means of reducing the sources of diarrheal disease, is usually the responsibility of agencies other than the health department. Such achievement, it was agreed, would result only from combined effort of all agencies, with encouragement from community organizations and active participation by individuals.

Though the importance of flies as vectors is recognized, fly control measures, according to the discussions, are less effective than piping water into individual homes. During peak periods of infection, suppression of flies should be encouraged, it was agreed, but with the realization that "flies are resistant to everything but sanitation."

Educational efforts were urged to explain the advantages of putting animal quarters in a separate building and to emphasize the ease with which food, particularly meat and fowl, can be infected during slaughtering and processing.

For treating dehydration, the principal cause of death in diarrhea victims, the prevailing opinion was that the local health agency should train suitable persons in simple methods. The chosen personnel, who must be acceptable to the families, should evaluate the adequacy of treatment facilities in the home and inform the mother of procedures to be used. The success of treatment hinges on how well the mother has been taught to recognize dehydration and on how promptly the treatment starts.

Turning to the financing and coordination of efforts by border communities, the participants advised cooperation by adjacent communities in defining joint problems, sharing observations and methods, and standardizing procedures. Communities can then either persuade higher-level agencies to take action, or they can rely on local resources. In many communities, a school teacher has been a key person in promoting the program, not only among pupils but also among families and local authorities.

Diarrhea Incidence Highest in Mexican Uplands

Mexico's highlands, in spite of their temperate or cold climate, have more diarrhea than other sectors when similar adverse environmental or social factors are present. This was one of the findings from field studies mentioned by Dr. Manuel E. Pesqueira, Deputy Minister of Health and Welfare in Mexico. Less diarrhea mortality occurs in tropical regions with abundant water and food. Attacks in these regions, though less frequent, may be more violent.

Although mortality from diarrhea in Mexico is decreasing, he emphasized that the rate of 235.2 per 100,000 persons for 1952–56 is still higher than for all other communicable diseases registered during that time. To develop more exact statistics on the disease, the Ministry is contemplating setting up one or more areas of careful registry in each state.

In almost all of the Mexican states, the government has projects for water supply systems, building public baths and laundries, improving homes, installing latrines, and destroying insect-breeding grounds. In all such communities, he said, health education and maternal and child health are stressed. Mothers are taught correct baby care and feeding and are trained in home sanitation, aspects of home economics, and home care of sick children, including prevention of dehydration when diarrhea strikes.

Mexican VD Health Workers Trained in Mobile Units

In a detailed description of how a mobile unit contributes to the Mexican venereal disease campaign, Dr. Alfonso Verduzco Peñafiel, epidemiologist with the antivenereal campaign of the Mexican Ministry of Health and Welfare, related that the unit was first acquired by the Ministry in 1956 both to train personnel and to standardize control techniques throughout the country.

In addition to a laboratory for technician training and for evaluating local laboratory facilities for syphilis serodiagnosis, the unit has audiovisual units for health education and material for serologic tests, treatment, and prophylaxis.

A teacher of health sciences specializing in the program techniques and a trained contact interviewer comprise the unit's personnel, he said. After presenting the program's objectives, methods, organization, and personnel to local officials, the team begins fieldwork with public health nurses seeking such training. Among the groups tested are prostitutes, prisoners, and soldiers. The unit supplies the local laboratory with basic equipment and mate-

rial for diagnosis and trains the health personnel in campaign methods.

For treatment of prostitutes, the team recommended weekly dosages of 300,000 units of penicillin procaine with aluminum monostearate or 600,000 units of penicillin benzathine every 2 weeks.

Goals for Community Action Against Alcoholism

What should the community do about alcoholism? What would you like to see in your community 20 years from now? Here are some of the things that I think can be attained in the next 20 years, if we make use of the things we now know:

★ Citizens who recognize that some people cannot drink in moderation and that those people cannot be blamed for the conditions that made them alcoholic. In other words, an informed public.

★ Police officers who have some knowledge of alcoholism and who consider helping alcoholics part of their job as well as protecting the rights of others.

★ Courts and laws which recognize that help for the alcoholic is far more effective than is punishment.

★ Physicians who are ready, willing, and able to treat the acute phases of alcoholism and to use their skills to join with the community team that offers help for the chronic aspects of the illness.

★ General hospitals whose beds are as available to acutely intoxicated patients as they are to diabetics, and nursing staffs who recognize that there is more to alcoholism than intoxication.

★ Clergymen who are aware of the spiritual problems faced by alcoholics and their families and are ready to use their counseling skills to help rather than condemn.

★ Social agencies who offer their help to families where alcoholism has intensified normal social problems and who use their skills to help the individual alcoholic.

★ Health departments that feel as much responsibility toward alcoholism as they do any other public health problem.

★ Employers who recognize the early symptoms of alcoholism in employees, and who protect the investment they have made in these people, by getting help for them before they jeopardize their jobs.

—RALPH W. DANIEL, *executive director, Michigan State Board of Alcoholism (from a speech given at the Midwest Institute on Alcohol Studies, June 23–27, 1958).*

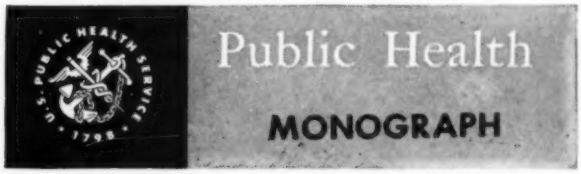
Environmental Factors and Enteric Disease

COAL MINING communities with diversely housed population groups in eastern Kentucky were the locales of a field study to provide basic information for development of specific control measures against diarrheal diseases by determining seasonal and annual prevalence of diarrheal diseases among human populations of areas differing from one another in one or more environmental characteristics, identifying contributory factors in diarrheal disease in the different communities, and evaluating levels of sanitation in households and in the communities studied.

The study was conducted by the Communicable Disease Center of the Public Health Service with the cooperation of the Kentucky State Department of Health. During the period of study, observers determined diarrheal disease morbidity rates, *Shigella* infections in preschool children, and percentage of population infected with *Ascaris*, in 11 communities. Marked seasonal trends in reported morbidity were recorded, the highest incidence occurring during August and September. The ratio of "summer" diarrhea to "winter" diarrhea for the years 1955 and 1956 was approximately 2 to 1. Diarrheal disease prevalence increased earlier in the spring and persisted at a high level longer in the fall in areas where sanitation was least observed. Severe diarrhea was more frequently reported from the less sanitary areas.

Shigella prevalence rates obtained by rectal swabbing of preschool children ranged between 0.7 percent and 10.2 percent in individual study areas. The highest prevalence for all study populations combined occurred in the 4-year age group; in the least sanitary areas children were found to be infected at an earlier age, and the highest prevalence was in the 2-year age group. Variations in *Shigella* prevalence did not correspond to seasonal variations in reported diarrheal morbidity. Shigellosis was responsible for the majority of acute diarrheal disease experiences observed in areas lacking sanitation, but was not a primary cause in the best sanitated area. *Salmonella* and the enteropathogenic *Escherichia coli* evidently did not contribute substantially to diarrheal disease morbidity reported in the study areas.

One of every four of the 2,798 individuals of all ages examined had stools positive for *Ascaris lumbricoides*. In the particular region



No. 54

The accompanying summary covers the principal findings presented in Public Health Monograph No. 54, published concurrently with this issue of Public Health Reports. The authors are with the Communicable Disease Center, Public Health Service, Atlanta, Ga., and the Hammond City Health Department, Hammond, Ind.

Readers wishing the data in full may purchase copies of the monograph from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. A limited number of free copies are available on specific request to the Public Health Service. Copies will be found also in the libraries of professional schools and of the major universities and in selected public libraries.

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Schliessmann, D. J., Atchley, F. O., Wilcomb, M. J., Jr., and Welch, S. F.: Relation of environmental factors to the occurrence of enteric diseases in areas of eastern Kentucky. Public Health Monograph No. 54 (PHS Pub. No. 591). 35 pages; illustrated. U. S. Government Printing Office, Washington, D. C., 1958. Price 30 cents

studied, *Ascaris* infection rates were found to be at least as suitable an index of enteric disease prevalence and of environmental sanitation as *Shigella* infection rates. In the group 2 to 12 years of age, *Ascaris* infection rates ranged from 12 to 70 percent among the study populations. Rates of *Trichuris trichiura* approximated those of roundworm, although the whipworm infections, as judged by egg counts, were almost invariably much lighter. *Strongyloides stercoralis* infections were occasionally recorded and hookworm infections were rare. Prevalence of *Entamoeba histolytica* did not exceed 3.3 percent; *Giardia lamblia* and the remaining intestinal protozoa recorded prevailed at rates corresponding to ranges reported elsewhere in the United States.

Comparatively low levels of fly abundance, including houseflies, were evident in the areas under study. While it may logically be assumed that flies as mechanical vectors contributed to the reported morbidity rates and *Shigella* prevalence, the level of fly-transmitted diarrhea during the period of study was too low to be measured by the indexes available. Similar conclusions were reached with respect to studies of the role of water in enteric disease transmission. With the exception of one public supply and a very few properly constructed drilled wells, water sources in use by the study populations were subject to possible fecal contamination and may have been responsible for some cases of diarrheal disease. There were, however, no instances in which water quality could be implicated in localized outbreaks or correlated with seasonal differences in morbidity rates or *Shigella* prevalence.

Lowest rates of reported diarrheal disease, *Shigella*-positive cultures, and *Ascaris*-positive stools were recorded among study families served by complete community sanitary facilities; markedly higher rates of all three enteric disease indexes were experienced by households served by some but not all public sanitary services; and the highest levels of the three indexes were reported from populations living where community sanitary facilities were entirely lacking. Individuals living in homes provided with inside piped water and privy excreta disposal experienced approximately twice the diarrhea, twice the *Shigella* prevalence, and four times the *Ascaris* prevalence experienced by individuals using inside piped water and flush toilets. Where water was not piped inside the house, persons having access to water on the premises experienced approximately a third less diarrhea than individuals obtaining water away from the premises. Where the water source was outside the dwelling unit, *Shigella* prevalence and *Ascaris* infection rates were comparable regardless of the location of the water source in relation to the premises.

Of several socioeconomic factors analyzed for possible influence upon enteric disease rates, only crowding, family size, and education of the mother appeared to affect rates appreciably. High person-per-room ratios, large families, and low educational levels of the mother all generally accompanied high *Ascaris* and *Shigella* prevalence. The combined effect of these factors on observed prevalence of diarrheal disease was not, however, as great as the lack of adequate sanitary facilities.

Results of these studies strongly support the premise that incidence of acute infectious diarrheal disease may be significantly reduced through selective modification of specific environmental factors within communities without regard to etiological or sociological differences.

Calculating Home Range and Density of Small Mammals

TWO interrelated aspects of animal population ecology are considered in this monograph. First, a mathematical formulation describes how individual animals use the space radiating from their homes. This space is designated as home range. Second, from this formulation, mathematical formulations are developed for estimating density by the use of capture data.

The probability of recording an animal per unit of area about its home or center of activity is adequately described by the bivariate normal distribution function. The farther a locality is from the center of an animal's activity, the less likelihood there is that the animal will be observed there.

In estimating density, it is customary to use some sampling device which has a discrete location in space. Obviously, some animals will live close to this device and others farther away. Where the use of space is describable by the bivariate normal distribution function, those animals living close to the sampling device will have a higher probability of being sampled than will those living farther away. With this insight into home range, it is possible to arrive at reliable estimates of density from a sequence of samples representing portions of the population removed.

Although the data in this monograph concern certain mice and other small mammals, application of the formulations presented can lead to much more precise information than is now available on the role of mammals in the epidemiology of diseases for which they serve as reservoir hosts.

The formulations concerning home range are of particular relevance in the study of animal behavior and population dynamics. They provide a basis for understanding the phenomenon of territoriality as well as a basis for measuring contact rate among members of an animal population.

Public Health
MONOGRAPH

No. 55

The accompanying summary covers the principal findings presented in Public Health Monograph No. 55, published concurrently with this issue of Public Health Reports. The senior author is with the National Institute of Mental Health, National Institutes of Health, Public Health Service, Bethesda, Md.; the junior author is with the Eastern Pennsylvania Psychiatric Institute, Philadelphia, Pa.

Readers wishing the data in full may purchase copies of the monograph from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. A limited number of free copies are available to official agencies and others directly concerned on specific request to the Public Health Service. Copies will be found also in the libraries of professional schools and of the major universities and in selected public libraries.

• • •

Calhoun, John B., and Casby, James U.: Calculation of home range and density of small mammals. Public Health Monograph No. 55 (PHS Pub. No. 592). 24 pages. U. S. Government Printing Office, Washington, D. C., 1958. Price 25 cents.

Signs and Symptoms

of Trends in Public Health

"How To Be a Nursing Aide in a Nursing Home," a manual produced by the Public Health Service and the American Nursing Home Association, will be used by the Army as a text for inservice education in hospitals.

« »

Improvement in sanitation of food stands operated by the blind resulted from recent Public Health Service inspections in Federal buildings in Denver, Colo.

Responding to a specific request by the General Services Administration, the inspectors found that sandwiches with perishable fillings were not being properly refrigerated. Mechanically refrigerated display cases were promptly procured by the Colorado Division of Rehabilitation for the Blind. By this action, blind operators have increased the number and variety of perishable products offered for sale, with a consequent improvement in sales.

« »

A survey by the North Carolina Industrial Commission unearthed the fact that, over a 24-month period, 75 percent of the accidents happened to workers who had not eaten breakfast. The largest number of injuries occurred at 10 a. m.

« »

Portable kerosene heaters are prohibited at farm labor camps in New York State by an amendment to the State Sanitary Code. Approximately 35,000 migrants who work in more than 1,060 farm labor camps in the State each year will be affected.

Applicants for permits to operate camps will have to apply at least 30 days prior to the first day of operation, rather than 15 days as at present, according to another amendment.

Other amendments require hot and cold water at all bathing facilities of camps having a capacity of more than 25 people; heating facilities at camps occupied between October 1 and May 1; fire-resistant construction of new dwelling units housing 3 or more families or 15 or more persons; a minimum sleeping area of 40 square feet per person; and screens on all windows and exterior openings of living quarters.

Some of these changes are effective in 1959, others not until 1962.

« »

In Columbus, Ohio, the editors of the Ohio State Department of Health's monthly magazine left the beaten trail in September 1957 to produce an issue composed entirely of letters of inquiry from the public and answers to these letters by members of the health department's staff.

« »

With the aid of Hill-Burton funds, some States are allocating 36 percent of all new beds to chronic facilities, including nursing homes.

« »

Getting On—Safely, a recent 12-page publication of the National Safety Council, emphasizes special environmental aids and personal practices which can be used to prevent those types of accidents to which persons in the over-65 year age bracket are particularly susceptible.

The pamphlet is directed to the older person. A separate insert sheet, When An Elderly Person Lives With You, offers suggestions to the younger adult who has the responsibility for the care of an elderly person.

Single sample copies are available, without charge, from the National Safety Council.

« »

Permits from the New York Department of Public Works are now required for industries that discharge industrial wastes into sewers which lead to sewage disposal or pollution control plants. Alcohols, antibiotics, arsenic, iodine, copper and copper salts, fluorine, formaldehydes, mercury, silver and silver compounds, zinc compounds, and such agents as nitrates and sulphides may be discharged into the sewer system only when diluted by other sewage to meet set standards. Eventually, fees will be charged for treatment of commercial wastes.

« »

Pamphlets entitled "Problems in Intercultural Health Programs," by George M. Foster, "Social Status and Public Health," by Ozzie G. Simmons, and "Effects of Social and Cultural Systems in Reactions to Stress," by William Caudill, were published by the Social Science Research Council, New York, N. Y., during the spring of 1958.

The Committee on Preventive Medicine and Social Science Research, appointed by the council, commissioned the publication of these pamphlets. Harold F. Dorn and H. van Zile Hyde of the Public Health Service were members of the committee.

« »

Aruba, a Caribbean island, has installed a $10 million steam distillation plant to derive fresh water from the sea. The plant extracts 2,700,000 gallons daily at a cost of about $1.50 per 1,000 gallons. (Domestic water usually costs 10 to 25 cents per 1,000 gallons.)

« »

"Water Fluoridation: Facts Not Myths" and "Cell Examination—New Hope In Cancer," Public Affairs Pamphlets Nos. 251 and 252, have been published by the Public Affairs Committee in New York City.

publications

Selected Materials on Staphylococcal Disease. *PHS Publication No. 627; 1958; 237 pages; $1.25.*

Selected reprints of articles from medical journals, information on teaching aids, list of additional readings, locations of phage typing centers, and recommendations of several professional associations are provided for instructors, physicians, nurses, and laboratory personnel.

This book may be used either as a refresher document or for orientation.

Accidental Injury Statistics. *PHS Publication (unnumbered); 1958; 61 pages.*

Salient facts about injuries and deaths from accidents in the United States are presented in a series of charts and tables prepared for health departments and agencies concerned with accident prevention.

The report is divided into sections dealing specifically with incidence of nonfatal injuries, leading causes of death, trends in accidental deaths over a 50-year period, types of accidents, relationship of accidents to marital status, and place of residence.

National Health Survey data collected in sample household interviews, figures provided by the National Office of Vital Statistics, and information contained in several selected studies of accidental injuries are included.

Statistical Summary of Sewage Works in the United States. *PHS Publication No. 609; 1958; by John R. Thoman and Kenneth H. Jenkins; 40 pages; 20 cents.*

Based on the 1957 Inventory of Municipal and Industrial Wastes Facilities, this report summarizes and analyzes data on community sewage disposal works in the United States.

Comprehensive data for all phases of sewage collection and treatment are tabulated according to States, population size groups, and major drainage basins. Detailed analytical tables are given and comparisons are made with appropriate prior information.

This report provides the background information for use in conjunction with PHS Publication No. 619, Municipal Sewage Treatment Needs.

Indians on Federal Reservations in the United States. A digest. Billings Area. *PHS Publication No. 615, part 2; 1958; 17 pages.*

Brief information about each of the eight Federal Indian Reservations in Montana and Wyoming is contained in this digest.

The population groups, their homes, education, and income, and their health status and services are discussed. Included also is a description of the location, ownership, and topography of the reservation land.

Physicians' Handbook on Death and Birth Registration. *PHS Publication No. 593; 1958; 11th edition; 38 pages; 20 cents.*

A minor revision of a publication issued in 1949, this booklet contains facts which the practicing or prospective physician should know concerning birth, death, and fetal death registration requirements and procedures. Selected references are presented and vital statistics offices listed alphabetically by State or Territory.

Using Your Community's Health Resources. *Department of Agriculture Rural Research Leaflet No. 5; 1958.*

Steps aimed at improving use of available health services to meet rural community health problems are listed in this leaflet, prepared jointly by the Department of Agriculture and the Public Health Service. Suggestions include a study of the local situation, closer cooperation between local private and public groups, assessment of present health facilities, and a communitywide campaign to promote better health.

Written in nontechnical language, the leaflet should be useful to public administrators, civic leaders, county agents, farm organizations, and clubs. Copies may be obtained from the Publications Office, Agricultural Marketing Service, U. S. Department of Agriculture, Washington 25, D. C.

Good Water Makes Good Neighbors. *PHS Publication No. 626; 1958; 7 pages.*

This pamphlet was designed to alert women's clubs to the urgency of the Nation's water pollution problem. It provides a brief outline of the situation, suggestions for action by women's clubs, and discussion topics.

Published Scientific Papers of the National Institutes of Health, 1957. *PHS Publication No. 618 (Public Health Bibliography Series No. 23); 114 pages.*

Papers presenting original work of scientists at the National Institutes of Health, Public Health Service, published during 1957 are listed in this bibliography. Titles are arranged by institute, division, and laboratory to which the senior author was attached when the work was done.

An author index shows the extent of multidisciplinary approach to research problems and reflects the contribution of all authors as well as each unit.

This section carries announcements of new publications prepared by the Public Health Service and of selected publications prepared with Federal support.

Unless otherwise indicated, publications for which prices are quoted are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Orders should be accompanied by cash, check, or money order and should fully identify the publication. Public Health Service publications which do not carry price quotations, as well as single sample copies of those for which prices are shown, can be obtained without charge from the Public Inquiries Branch, Office of Information, Public Health Service, Washington 25, D. C.

The Public Health Service does not supply publications other than its own.

ECHOES from Public Health Reports

TULARÆMIA Francis 1921.[1]

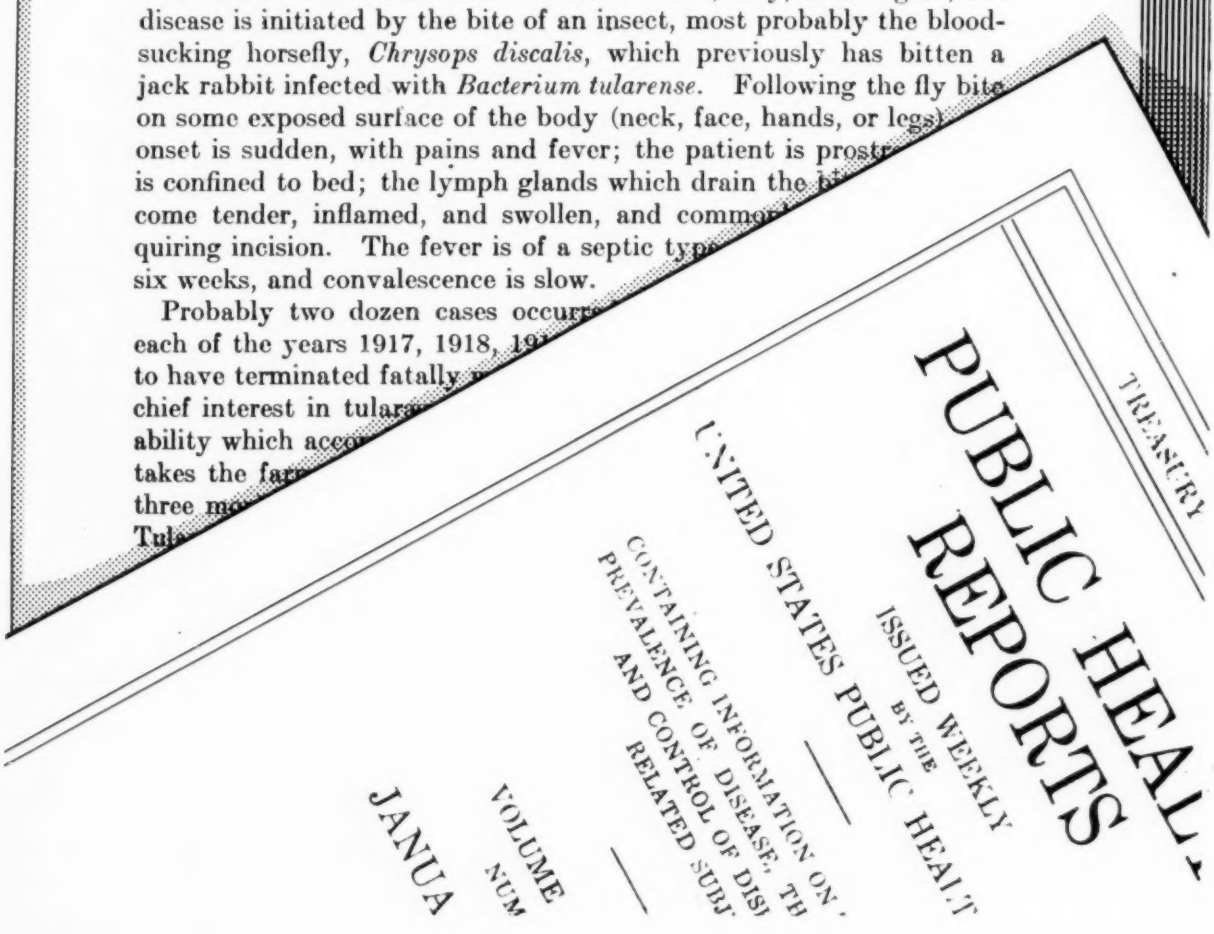
I. THE OCCURRENCE OF TULARÆMIA IN NATURE AS A DISEASE OF MAN.

By EDWARD FRANCIS, Surgeon, United States Public Health Service.

Tularæmia is a specific infectious disease due to *Bacterium tularense* and is transmitted from rodents to man by the bite of an infected blood-sucking insect or by the handling and dissection of infected rodents by market men [2] or laboratory workers.[3]

As observed in Utah in the months of June, July, and August, the disease is initiated by the bite of an insect, most probably the blood-sucking horsefly, *Chrysops discalis*, which previously has bitten a jack rabbit infected with *Bacterium tularense*. Following the fly bite on some exposed surface of the body (neck, face, hands, or legs) onset is sudden, with pains and fever; the patient is prostr is confined to bed; the lymph glands which drain the bi come tender, inflamed, and swollen, and commonly quiring incision. The fever is of a septic type six weeks, and convalescence is slow.

Probably two dozen cases occurr each of the years 1917, 1918, 19 to have terminated fatally chief interest in tular ability which acco takes the far three m Tul



JULY 29, 1921, pp. 1731–1738

Dr. Edward Francis figured prominently in identifying tularemia as a disease of man and in delineating the method of transmission in nature.

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Public Health Reports

Volume 73, January–December

and

Public Health Monographs

Numbers 51–55

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The subject index carries one or more entries for each item published. In addition to the subject headings, categorical headings include ANNOUNCEMENTS (ORGANIZATIONS, PERSONNEL, and SCHOOLS), CONFERENCE REPORTS, DEATHS, FILMS AND FILMOGRAPHS, FRONTISPIECES, LEGAL NOTES, MONOGRAPHS, PUBLICATIONS, and TRAINING COURSES.

Public Health Monographs published concurrently with *Public Health Reports* in 1958 are listed in numerical order under the category heading MONOGRAPHS. The monograph summaries appearing in the journal are indexed under appropriate subject headings.

One asterisk before the page number indicates an original, signed article. The sign of two asterisks, used only in the author index, indicates a monograph. Entries without any symbol may refer to summaries or briefs of papers presented at conferences, narrative conference reports, statements or reports of committees, short reports without authors, or similar items.

Illustrative material on the inside of the front cover of each issue is indexed by month under the heading FRONTISPIECES. It is recommended that the covers be included in a bound volume.

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CORRECTIONS

MAY, p. 386, table 2 of the article entitled "Ejection and Automobile Fatalities," by Boris Tourin, the total figure for fatally injured persons expected should read 53.32.

JUNE, p. 510, reference 6 of the article entitled "Mass Therapy in Attempted Control of Amebiasis in a Mental Institution," by M. M. Brooke, Ralph H. Heeren, Grace M. Sawyer, and Dorthea Stoner, the source should read Am. J. Hyg.

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